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THE

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or Monthly Journal of Geology:

WITH WHICH IS INCORPORATED

'THE GEOLOGIST.'

NOS. VII. TO XII.

EDITED BY

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LIST OF PLATES.

PLATES		PAGE
I. II.	Anthrakerpeton, Coal, South Wales	8
III.	Palæocetus, Boulder-clay	56
IV.	Surface-marks on Carboniferous Sandstone	137
V.	Woodocrinus, Mountain-limestone	163
VI.	Alpine Structure	193
VII.	Sections near Llandudno, North Wales	200
VIII.	Echinodermata, Mountain-limestone	251
IX.	Wood in Chalk-flint, Winchester	292
X.	Mammalia, London Clay	341
XI.	Crustacean Teeth, Scotland	403
XII.	Flemingites and Lepidostrobus, Coal-measures	440
XIII.	Caulopteris, Upper Greensand, Shaftesbury	487

LIST OF WOODCUTS.

Base of tooth of *Anthrakerpeton*	6
Cranial bone of *Anthrakerpeton*	7
Actinocrinus brevicalix	12
Section of strata near Ryde, Isle of Wight	46
Sections of Mont Salève	52
Diagram of Upheaved Beds	53
Diagram across the London Basin	65
Langdale Pikes, seen from Blea Tarn	94
Section of a Natural Pit near Lexden, Essex	101
Section of the Antwerp Crags	105
Section of the Carboniferous Rocks near Oswestry	108
Section of the Coal-measures at Kingswood	111
Portion of the Jaws of *Stereodus Melitensis*	146
The Idol and Pulpit Rocks.—Brimham rocks	156
Section of the Carboniferous rocks of South Wales	159
View of the Pennant Rocks	159
View of Ebbw Vale	160
Section of Kunjamullay	173
The common Sand-hopper in its burrow	191
Inversion of Cretaceous upon Tertiary Strata near Mentone	206
Section of the Natural Pit at Lexden, in 1862	231
Diagram to explain the formation of the Lexden Pit	232
Section of the Mountain-limestone at Corwen	283

PAGE
View of Goat Crag, Cumberland 301
Detached Blocks in Kirkstone Pass 301
The Pillar Rock, Ennerdale 305
Sections of the outlier of Carboniferous limestone at Corwen . 326, 327
Section of the rocks of North Wales 344
Section of the Vale of Clwyd 380
Sketch of Bray Head, Wicklow 389
Section of the Cambrian Rocks at Bray Head 390
Oldhamia antiqua, *Arenicolites didyma*, and surface-tracks . . . 391
Oldhamia antiqua, Cambrian, Carrick Mountain 394
Oldhamia radiata, showing successive layers 395
Histioderma Hibernicum 398
Fragment of Rock, grooved and polished by Ice 442
Turrilepas Wrightii, Wenlock Shale, Dudley 470
Section from Sandy Bay *vid* Hobart to New Norfolk, Tasmania . . 492
Ideal Section of Hobart from Mount Wellington to Derwent River . 493
Section in the Lightmoor Railway Cutting 515
Porana (?) *Vectensis* and *P. Œningensis* 516
Section near Ely 530
Section in the Ely Pit 532
Structure of Fruit of Calamite 545

THE

GEOLOGICAL MAGAZINE.

No. VII.—JANUARY 1865.

ON SOME POINTS IN GEOLOGY AS SEEN TO-DAY.

By the EDITOR.

IN our introductory observations on the past and present aspects of Geology, in No. I. of this MAGAZINE, we alluded to some special points much discussed now-a-days, such as 'the origin of granite, the mode of formation of river-valleys, the excavation of lake-basins, the doctrine of homotaxis, and the origin of species.' During our six-months' existence, we have witnessed some advance in geological knowledge along these lines of research, though we cannot say that granite is much less mysterious, river-valleys and lake-basins far better understood, or the contemporaneity and succession of species more easily explained, than heretofore. Yet geologists hold a taper in the darkness—a feeble light, showing the thick mist, and but little of the footway. Along this darksome path have gone the flitting letter of the ready writer, the weightier essay, the pamphlet, and the book,—all intended to be lights or signposts, and often fit and good. Indeed many have tried to illumine this track through the history of the past; and now where do we stand, and what can we discern around us?

The four or five points of discussion above alluded to are necessarily of great importance to the Geologist; and he can study them only with the help of Zoologist, Botanist, Physicist, and Chemist; and he must be palæontologist, mineralogist, and versed in the dynamics of geology, if he expect to master them, for they refer to nearly all the divisions of his science. So close are the relations of fossils to strata, and of strata one to another and to other rock-masses, and of these to the earth as a whole, its atmosphere, its uneven surface of land and water, and all its living creatures, that, if we knew the history of species, their rise, succession, and distribution,—if we understood the modes in which all muds and sands and gravels have come down from high to lower levels, making heaps and shifting in beds, until, fixed by their own weight, and crushed perhaps in the foldings of a mountain-ridge, they are hard bound by chemical change, waiting for air and water to set them free to act their part again,—if we knew all this, we should indeed be complete geologists, standing on our highest point! But what can we see now? Do we see granite mountains, of recent date, 'piercing through the older mountains, and pushing them aside all around,' fancying that 'they have risen like giants even above the clouds, raised by the power of the hidden fires'? Not so. We have learnt of late, that, in accordance with the general structure of the globe, continental areas may be regarded as portions of the earth's crust, crumpled at their edges by the lateral pressure effected by the sea-areas being dragged downward by contraction; and that this crumpling has produced elevated ridges or mountains, together with changes in the strata; limestones becoming marble; coal being purified into anthracite and graphite, and, may be, diamond; sands changed to quartzites; clays and muds to slates and schists; nay, even gneiss and granite coming out from the further process of squeeze and heat and change of moist strata; the former structure lost, but the original elements still remaining; the silica and alumina, and their associated alkalis, metals, and so forth, being rearranged in crystalline and often gem-like forms. From another point of view we see horizontal and unaltered beds at first slightly undulated, then thrown into curves and sharp folds, their substance altered, even porphyries and trap-rocks here and there representing some of their layers, their fossils vanishing, their bedding scarcely traceable and crossed by planes of cleavage, as we go up the mountain-gorge. But if we do not lose sight or thought of the great curvatures and folds, we can still track out the comparatively thin and once bedded mass, a few hundred feet in thickness, now folded and crumpled into elevated ridges of altered rock, and passing into a compressed heart of gneiss and granite,—the axis of the range, or nearly so. And this may altogether be not even of Palæozoic age; but Triassic beds, Jurassic, Cretaceous, or even Tertiary, may form the mass. Many a range of so-called primeval granite, gneiss, and slate, lapping one over the other successively for hundreds of thousands of feet, or of upright 'primary schistus,' miles across, will exhibit to the geologist of to-day only many times repeated folds of an altered set of strata; nor will their furthest change, or granitic form, be taken either for primeval or intrusive granite: and, whilst the latter may still be found, the former, or the hypothetical granite of a cooling globe, becomes a myth.

Take America for example: we cannot follow Rogers across the Alleghanies, Hector across the Rocky Mountains and Vancouver, Whitney across the Californian ranges, Wall through Venezuela, Trinidad, and Jamaica, and D. Forbes across the Andes, without seeing the true relations of granitic and schistose rocks to strata. Sir William Logan's accurate sections of Canada, when published, will show pre-eminently how gneissose rocks are bedded rocks; quartz and silicates (felspar, mica, hornblende, &c.) replacing the sands and clays of early deposits: old shingle-beds are among them still, and their great marble-beds are now known to be, partly, at least, of organic origin, like other limestones,—the foraminiferal *Eozoön* having built them up by reef-like masses; and their granites may have been coal, and their iron-ore and phosphates were probably formed, as now, in association with organic matter. The great "Laurentian" gneiss of Canada, Norway, and elsewhere, the oldest rock found by geologists stepping down from bed to bed, stage to stage, from one rock-system to another, from the present to the past, is sometimes almost a granite, sometimes almost a syenite, but still presents itself as a crumpled altered bedded rock, made of the old detritus of unknown shores, and associated with limestones of organic origin, just as sands, muds, shell-beds, and microzoal ooze are now formed in shallows and the deep. And if the Eozoon shell-coat, with its infilling of silicates, alone presents itself as witness of that unknown sea, are we to suppose that there were no other species then? Have we got back to the first of earth's created beings? It is lowly and simple as an organism; the name of its natural order says as much—it is a Protozoan: ought it not to have been verily the first? That is not for us to say. There are two things to be remembered—1st. It owes its preservation to the silicates of magnesia, alumina, &c. having filled its tubes and chambers in that old sea, just as a silicate of iron, alumina, &c. fills similar shells in the sea to-day; the water yielding different salts at different periods. 2ndly. These similar shells (Foraminifera) of the present and the past live at great depths, covering the sea-bed there, and heaping lime and silicates that can be preserved alone when the ocean-floor has been upraised, with its gradually augmented coatings, and fashioned as dry land. Judging by analogy, then, the Eozoon rock of Canada was the foraminiferal formation in one part of an ocean which elsewhere may have borne manifold and higher species, and buried them in sands and muds that have since lost all form and feature by the metamorphism of age and pressure, or which were altogether shorn away by wave and weather when the old ocean-bed was lifted up.

Eozoön Canadense, with its free growth, cell by cell, over the large area of a square foot, and tier above tier for five or six inches, far exceeds even the wildest and most [illegible] or sponge-like of its existing representatives; and in this light we might think of it as a more repetitive and less specialized form: but it stands higher than the free-growing forms that we know, for it has a shell-structure of as delicate and high an organization as the highest Foraminifer—*Nummulina*. To that species it may be said to supply a free-growing form or condition, such as other species have: but that this old Laurentian creature was essentially lower in the scale of being than its young Nummuline brother, is not the opinion of Dr. Carpenter, who has thought over it with the results of Dr. Dawson's and his own examination of the fossil before him.

A friend informs me that his microscope shows Eozoan structure in some of the green and white marble of Connemara. There then Laurentian rocks may be looked for. Sir Roderick Murchison demonstrated their existence in N.W. Britain; Dr. Holl has boldly argued that a Laurentian heart holds up the Malvern range;

Salter discerns traces of these old rocks in Wales. In fact, all the *metamorphic* rocks are being referred to either one or other of the great rock-systems or groups of sand, mud, and limestone that have succeeded one another with the changing outlines of land and sea; thus the Cretaceous limestones, clays, and sands (our Chalk, Gault, and Greensand), unaltered in England, are changed to marble, slate, and crystalline schist in Greece and elsewhere; and in California, as Mr. Whitney tells us, these and other Secondary strata are metamorphosed into the gold-bearing mountain-rocks. There is no evidence now of an 'azoic' period, nor is there a separate underlying 'metamorphic system,' such as old school-books teach; and thus one hindrance in threading the maze of mountain-structure is removed.

As we have now more correct views than heretofore as to the internal structure of mountains and continents, so we may regard as approximately true our notions of the methods by which the tops and flanks of ridges have been chiselled out of the upraised strata, hard and soft, crystalline and earthy, bent, folded, and overturned, as the case may be; and by which the slopes and plains were laid out, and channelled with converging drainage-lines, that begin at the crest of the neighbouring mountains and reach to the sea, with snow-fields, glaciers, torrents, streams, tarns, lakes, rivers, and deltas characterizing this and that portion of their course. But in both cases we want very much information as to details; as to the different stages of the various operations, and as to the particular share taken by the several agents in the work. Of late the action of Glaciers has been a favourite study, and the actual work they now perform has been taken as a measure for the enormous effects of their transporting and grinding power when frost, snow, and ice reigned supreme in the northern hemisphere and on all high ranges. The frost breaks the surface of the rock, the glaciers carry the fragments along gorges and valleys, grinding those channels wider and deeper; and, removing the débris as far as they reach, drop it with icebergs into the sea, or, in milder climates, leave some of it as moraines, and give up a portion to the underworking river that runs from its foot. The glacier, like water, has followed a drainage-line;—did this channel first begin in the wear and tear of waves on an uprising shoal, or is the furrowed ridge itself a sharp-edged remnant of a great plain, worn smooth by waves, and then left to be eaten into by air and water, chemically and mechanically, until by little and little, by the wedging and grinding of ice, by storm and torrent, nearly all has been removed? In both cases (and they would each depend, in all their modifications, on length of time and rate of uprise, whilst the land was subjected to wave-action), it is possible that the drainage-lines would have their directions given them by slight inequalities of the surface, and differences in the texture of the rock; but it is argued that not only must the many cracks and faults traversing the strata (more than ever will be shown on any map), and the many lines of weakness along the edges of tilted and folded beds, have given primary direction to the great drainage-lines, but that for the most part the gorges of mountains, the rivers and fiords of rocky districts, and many smaller valleys and coombs, whether now occupied by water or not, indicate lines of fracture, and so assist in elucidating the structure of a country. And this is supported by the frequent coincidence of valleys with hitches and curves of strata; the more so, as the broken arches of long undulations, or of elliptical or other domes, exhibit such branching and radiating drainage-systems as actually correspond more or less to geometrical rules. Some ignore faults in strata as productive of any line of weakness such as would tempt a trickling stream along their course; but the outcoming of springs along faults may certainly have marked out valley-lines; and in limestone, at least, and granite, fissures of dislocation or of contraction do carry the water-streams, and the smaller rills converge to feed them.

In the history of the lower portions of river-valleys, we have been enlightened by the researches of Fergusson on the Bengal delta, Prestwich on some French and English rivers, Doyne on some rivers in New Zealand, Ellet on the Mississippi, and of other observers.

The origin of lakes is of great interest too. Many are merely dammed up valleys, like artificial reservoirs, always pressing against the gravel-heaps that hold them; some lie in expanded parts of valleys where soft rocks have been sapped away; but some seem to have been neatly hollowed out of hard rock, with definite edges, like a saucer; such are many mountain-tarns, and such are the great Alpine lakes, according to Ramsay and others. The glacier, in its course, impinging on the ground where the slope is favourable and a check is received, can, it is said, scoop out a basin for a tarn; and why, it is asked, should not the larger ice-masses of the Glacial Period have ground out the larger, but not disproportionate lake-basins of Switzerland, even where neither fissures nor folds have weakened the rocky surface? Wind and sand may hollow out small rock-basins in rotting granite: a pebble, the plaything of the torrent or the tide, may worry out a pot-hole in the river-bed or on the sea-shore; but wind and water could not, it is thought, excavate such basins as the great lakes; and certainly they lie in the path of old glaciers. Their origin as glacier-beds has been denied, by saying that glaciers do not grind at all, and by other more forcible arguments, to all which Professor Ramsay has already given fair and powerful replies. The complete proof of his hypothesis may yet be wrung from the glacial phenomena of the greater mountains of the world.

For our part, the GEOLOGICAL MAGAZINE has already served as a channel for much valuable information on the vexed geological questions of the day; and amongst home and foreign news relating to the many topics that we have to deal with, our readers will continue to find facts and inferences as to how granite has been formed, how river-valleys and lake-basins have been excavated, and how species have come and gone.

ORIGINAL ARTICLES.

I. Description of some Remains of an Air-breathing Vert brate (*Anthrakerpeton crassosteum*, Ow.) from the Co shale of Glamorganshire.

By Prof. Owen, F.R.S., &c.

SINCE the discovery of remains of air-breathing Vertebrat in the Coal-shales of Carluke,* several other evidences a like grade of organization have been obtained from Scot Carboniferous deposits; but I had not, until the present ye seen any such fossils from English or Welsh formations of t same antiquity. The specimens figured in Plate I., howev give evidence of the fact. They were discovered by John Edwa Lee, Esq., F.G.S., in the much disturbed coal-beds at Lla trissent, Glamorganshire, which are referable to the lower p of the 'Middle,' if not to the upper part of the 'Lower,' Co measures.

The specimens include an impression of part of the integume with a few of the scutules, Pl. I. fig. 1; portions of long, slend curved bones like ribs, fig. 2; part of the roof of the craniu associated with a long, nearly straight, slender bone, and part o similar bone, slightly bent, figs. 3 & 4; portions of two straig slender bones, fig. 5; portion of a symmetrical bone, probably fr the naso-palatine chamber of the skull, fig. 6; portions of ribs, fig. parts near the articular ends bones, figs. 8 & 9. There is, al what seems to be the base o tooth, anchylosed to a rough risi of bone, according to the 'acrodo type, broken away from the alv lar border of a jaw, *cut*, fig. 1, *a*,

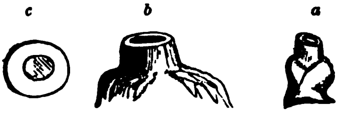

Fig. 1. *a*, Base of tooth, anchylosed to alveolar process; *b*, *c*, magnified.

The base of the tooth, fig. 1, *c*, has a full oval, almost circular, tra verse section, exposing a pulp-cavity, the diameter of which is h that of the fractured part of the tooth, surrounded by dense denti with a glossy fracture, without any distinct outer enamel or layer other substance: there is no trace of linear impressions on its exter although the part preserved corresponds to the beginning of the b of the tooth, where the inflections of the cement, which give rise the converging lines or labyrinthic windings, are seen in the teeth some Labyrinthodonts, in which the upper two-thirds or half of crown of the tooth may be entire.

The portion of cranial bone is impressed with small circular p which, toward one side of the bone, elongate and run into wavy groov anastomosing and causing the reticulo-striate and divergent impressions characteristic of Ganocephalous and Labyrinthodont cranial bones; *cut*, fig. 2. The expanded end of a long bone, Pl. I. fig. 8, has not terminated in a smooth, well-ossified surface supporting articular cartilage for a synovial joint, but has terminated, like some limb-bones in existing Perennibranchiate Batrachians, in unossified fibro-cartilage, showing in its present state the matrix in a finely granular state, surrounded by a thin film of bone: this rapidly thickens as the articular surface contracts into the shaft, where, at the point of fracture, a small subcentral unossified tract is exposed.

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* *Parabatrachus Colei*, Owen; 'Quart. Journ. Geological Society,' 1853, vol. p. 67, pl. 2, fig. 1.

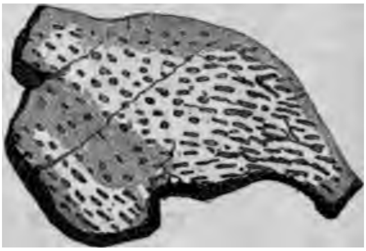


Fig. 2. Part of cranial bone (Pl. I. fig. 8); magnified.

The portion of bone fig. 9 indicates a similar incompletely ossified condition of the articular expansion; where, however, the thin outer crust of bone is continued from the periphery across the short diameter, leaving or marking out two unossified spaces filled by matrix, and which I infer, from Batrachian analogies, to have originally contained unossified cartilage. The side of the bone is longitudinally impressed, indicating the coalescence or connation of a pair of bones, and the fracture of the shaft, as in that of the connate tibia and fibula of the Frog, shows the confluence of the two unossified tracts into one, simulating a medullary cavity. The fractured ends of the other long and slender bones are remarkable for the contracted area of the corresponding cavity, and for the density and thickness of the surrounding bony wall.

Such a section is figured, magnified 50 diameters, in Pl. II. fig. 1; and microscopical evidence of the Batrachian character of the bone is given in fig. 2, longitudinal section, and fig. 3, transverse section, of the 'bone-cells,' magnified 222 diameters.

In both size and shape these bone-cells closely correspond with those of *Baphetes planiceps*, from the Pictou Coal, Nova Scotia.

The present portions of the skeleton of the air-breather from the Welsh Coal indicate a species intermediate in size between *Baphetes planiceps* and *Dendrerpeton Acadianum*. The ribs were longer than they are known to be in any Labyrinthodont; and they were better developed in that extinct group than they are in Ganocephalans or in modern Batrachians.

The structure of these long and slender bones, as of the thicker limb-bones, shows that the cavity was not truly medullary, but had been occupied by unossified chondrine, as in perennibranchiate Batrachia, and in the bones of many Fishes that are hollow after maceration, and show in the fossil state cavities, like medullary spaces, occupied by matrix.

I conclude from such evidence as has hitherto been submitted to me, and for which I heartily thank Mr. Lee, that the *Anthrakerpeton* from the Welsh Coal belonged to that low, probably primitive, air-breathing type, which, with developmental conditions of the bones like those in some Fishes, and very common in Devonian Fishes, showed forms of the skeleton more resembling those in Saurian Reptiles than are attained by any of the more specialized Batrachian air-breathers of the present day.

I propose, in reference to the characteristic density and thickness of the walls of almost all the long bones hitherto obtained of this air-breather, to name it *Anthrakerpeton crassosteum.*

EXPLANATION OF THE PLATES.

PLATE I.

Fig. 1. Portion of Coal-shale with impression of the integument and a few scutules.
2. Portion of Coal-shale with portions of two ribs.
3. Portion of Coal-shale with part of the cranium and of a long and slender bone.
4. Smaller portion of a similar bone on the opposite side of the shale.
5. Portion of shale with parts of two slender, straight, and pointed bones.
6. Portion of a symmetrical, grooved, flat bone; *qu.* from naso-palatine cavity?
7. Portion of shale with slender posterior ribs.
8. Articular end of humerus? or femur?
9. Articular end of connate leg-bones?

PLATE II.

Fig. 1. Transverse section of a long bone; magnified 50 diameters.
2. Section of part of the bone in the direction of the long axis of the bone-cells; magnified 222 diameters.
3. Section of part of the bone near the central cavity, taken transversely to the long axis of the bone-cells.

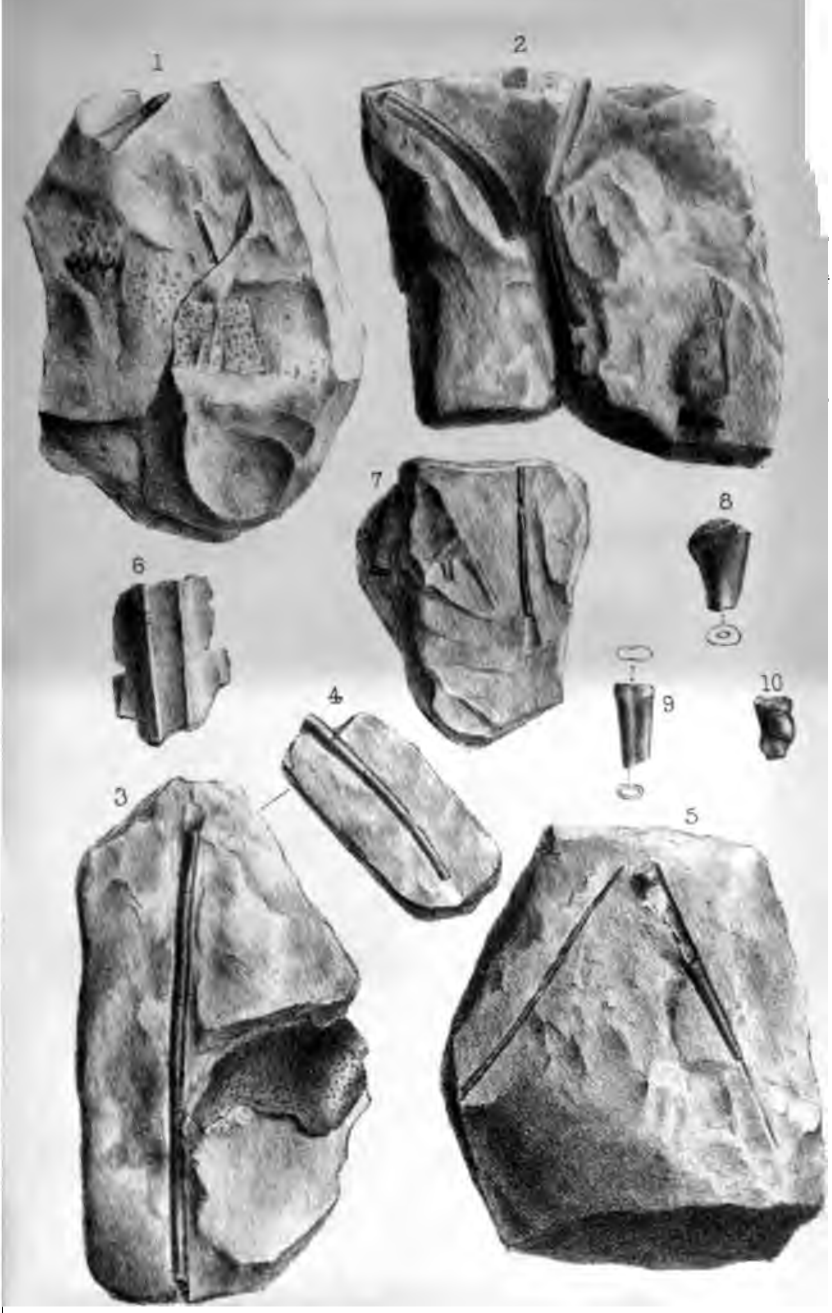
These sections were prepared, and the drawings of them made on stone, by JOHN EDWARD LEE, Esq., F.G.S., the discoverer of this extinct Coal Reptile.

II. ON THE BRICK-EARTH OF THE NAR.

By C. B. ROSE, F.G.S.

A POST-TERTIARY deposit, under the above denomination, lies upon the 'Drift' in the valley through which the River Nar takes its course towards its junction with the Ouse at Lynn; the united streams terminating in the Wash, an estuary bounded by the shores of Norfolk and Lincolnshire.

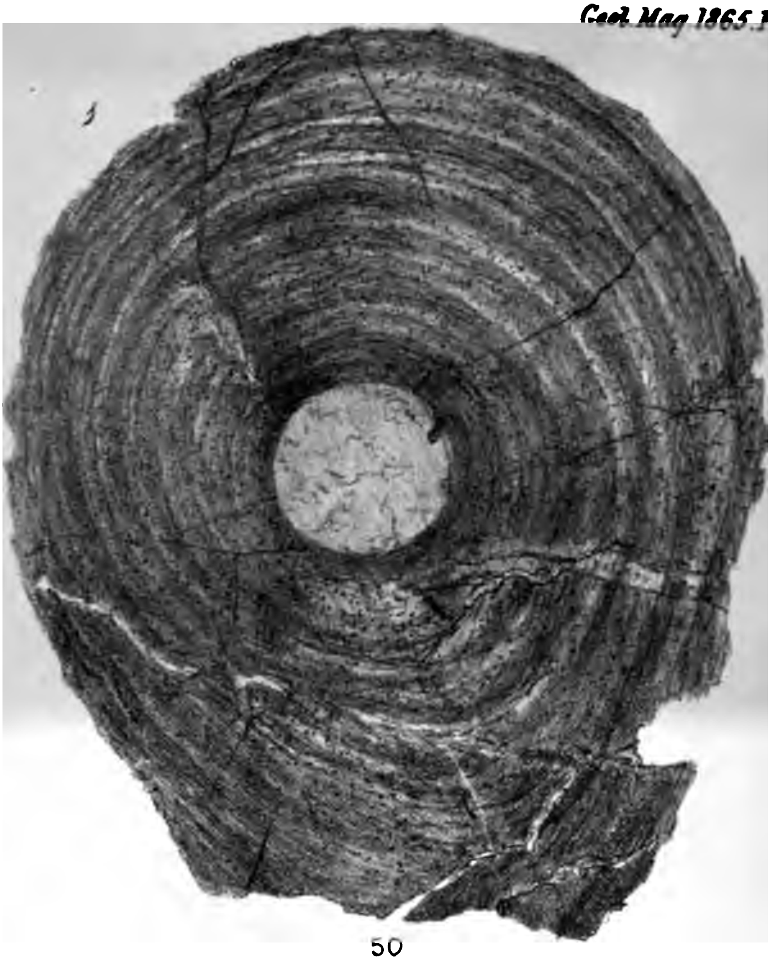
This Post-tertiary deposit I have traced along the valley from Narford to Watlington, a distance of about nine miles,



G. West lith.
M. & N. Hanhart

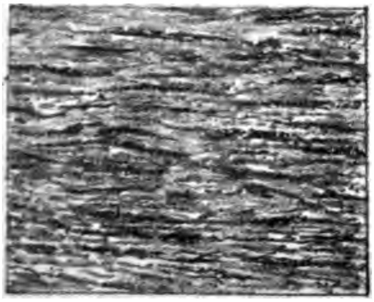
ANTHRAKERPETON CRASSOSTEUM.
from the Coal of South Wales.

1



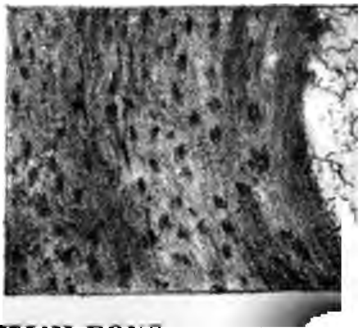
$\frac{50}{1}$

2



$\frac{222}{1}$

3



STRUCTURE OF REPTILIAN BONE.

(magnified)

and it contains several genera of existing Testacea. From its situation, physical composition, and animal contents, we may safely conclude that its site was, at a not very remote period (speaking geologically), the bed of an extensive sea-creek, receiving the water of the Nar and Ouse; its embouchure towards the German Ocean being what is now called the Wash; and that its present emerged state resulted from an elevation of the land, aided by a depression of the trough of the German Ocean.

Having in the 'Philosophical Magazine' for 1836, when I first introduced this deposit to the public, given a description of its character and position at certain localities, I shall now only contribute some additional localities, which I have examined since the above date; and give an extended list of the organic remains found therein.

I may here express my conviction that the geological era of this Nar deposit coincides with that of the Post-tertiary deposits of the basin of the Clyde.

At East Winch Brick-field, now levelled and deserted, the blue clay (mud) varies in thickness from two to twelve feet, and towards the deeper part it becomes a sandy silt, containing shells (particularly Oysters) in great abundance. A tooth of *Equus caballus* was found deep in the clay, in the presence of Sir C. Lyell, who in 1839 accompanied me to this and other localities of the deposit. At another time, a *Buccinum undatum* was taken up from a depth of twelve feet. An epiphysial bone of a Ruminant was also taken out of the clay here. In this yard, between the old diggings and the road, the brick-earth lies within a foot of the surface; it is light-bluish-brown clay, gradually passing into a blackish-blue as it descends; and it is covered by a sandy loam. At the surface of the clay, or rather in the upper few inches of it, shells of *Corbula nucleus* are profusely distributed, affording unmistakable evidence of its being an original bed of that mollusc.

In a drain at the back of Mr. Spinks's farm-house, near to West Bilney Church, the section is as follows:—Immediately beneath the vegetable soil there is a deposit of silt, to the depth of four or five feet, probably the accumulation of repeated warpings; then occurs one foot of moor (peat), containing roots, &c., and immediately beneath it the brick-earth, with its characteristic Shells. Bilney Brick-yard, described in 1836, lies near to this spot.

Two hundred yards to the north of the Car-stone-pit at the back of Bilney Hall, in the valley, on Bilney Common, and opposite to Foster's Farm at East Winch, is a pit among fir-trees, where I observed, 1st, an upper layer of sandy ochraceous loam, containing small angular, reddish flints, one foot; 2nd, a grey sandy loam, two feet; 3rd, blue argillaceous earth, as at the brick-yard, containing Oysters; this was sunk into four feet. In a portion of this pit a moor (peat) is visible lying upon the brick-earth, in which I understand Mammalian remains have been discovered.

On Pentney Warren, to the left of the East Walton Road, I found a moor (peat) containing all the fresh-water Shells of the neighbouring rivulets, lying immediately upon the marine brick-earth. In other parts of the Warren the brick-earth appears in a regularly horizontal bed, from three to four feet beneath a deposit of sand containing small angular flints, some of them having their angles slightly rounded off; this latter deposit having been in all probability the result of repeated inundations during the emergence of this district from beneath the water. On East Walton Common, adjoining the last-mentioned locality, may be seen in the margin of a pit containing water, a layer of large Oyster-shells, eighteen inches below the surface of the ground; and four feet below this layer, the Oysters, with *Aporrhais pes-pelecani*, and other Shells their usual associates, are jumbled together in great abundance.

In East Winch, at the late Mr. Foster's brick-yard, I observed that immediately beneath the vegetable soil lies a coarse red gravel, coarser than I have met with at any other site of the Nar brick-earth; it is here associated with a loam that is used to make a *red* ware; the blue brick-earth lying beneath this burns into an excellent *white* brick. The gravel and loam vary in thickness from two to seven feet; then appears the blue earth, which has been sunk into eighteen feet. It becomes darker as you descend, and at the depth of six feet you meet with large Oysters, forming layers, and a few are interspersed through the clay, associated with *Aporrhais pes-pelecani*, *Natica*, *Mactra*, *Buccinum*, and *Tellina*; a Horse's tooth was also found here. This locality is on the side of the valley opposite to Bilney Hall, and is a portion of the northern margin of the original creek. With regard to the occurrence of a *coarse* gravel upon the brick-earth at this locality, I am disposed to attribute it to the excavating power of the waves upon that gravel of which the high ground immediately bordering the creek at this spot consists; and consequently it must have in part have belonged to a subaërial proceeding. I had not adopted this view when I described this locality in 1836.

A section at the the Tottenhill Brick-field exposes the following beds. This locality is on the south-western border of the valley, adjoining to Watlington, beyond which parish this deposit of Shells has not been traced; the River Nar, in its valley, here trending northwards towards Lynn.

Section at Tottenhill Brick-field.

1st. Vegetable soil, and a loam composed of sand and clay, enclosing a great abundance of smooth and rounded flint-pebbles, some as large as oranges, and others of smaller sizes, chiefly of an oval form, precisely like those on a pebbly beach; there are also among them a few angular flints, with their corners partially rounded. Depth of this stratum 3 to 6 feet.

2nd. Blue brick-earth, containing but few shells until near the bottom of the pit, the depth of which is 14 feet. Large

Oyster-shells are met with in a layer at the depth of 12 feet within the clay; and beneath them *Aporrhais pes-pelecani*, and other mollusca, are plentifully interspersed. In this bed, also, some blackened fragments of wood occur.

3rd. The above two beds lie upon a blackish sand of the Lower Greensand.

No. 1 of this section exhibits a portion of the south-western shore of the former marine creek; and the pit in the Walton field near Narford, described in my original 'Sketch of the Geology of West Norfolk,'* leads me to consider that spot to be a part of the north-eastern margin of the same creek. The outline of this deposit may be readily traced on the Ordnance-map of the district. To my 'Sketch' I added a copy of that portion of the map.

I believe that I have now exhausted my memoranda relating to this deposit;† I have before stated that its traced length is about nine miles, its average breadth is less than a mile. It is difficult to determine its thickness; I was informed at West Bilney, that, when sinking a well, shells were brought up from the depth of 40 feet.

Organic Remains from the Post-tertiary Deposits of the Valley of the Nar.

Vermilia triquetra (on *Ostrea*); West Bilney.
Ostrea edulis; the majority large old shells; at all the localities.
Cardium echinatum, rare; East Winch.
C. edule; East Winch and West Bilney.
Corbula nucleus; East Winch and West Bilney.
Mactra subtruncata; East Winch and West Bilney.
M. solida; West Bilney.
Mytilus edulis; Pentney-Warren.
Pecten varius; West Bilney and Walton Field.
Tellina solidula; West Bilney and East Winch.
T. proxima; Tottenhill.
Cerithium reticulatum; West Bilney.
Turritella communis; West Bilney and East Winch.
Nassa incrassata; West Bilney.
Aporrhais pes-pelecani; very abundant at all the localities.
Litorina litorea; very numerous, of all ages, and at all localities.
L. litoralis; rare; West Bilney.
Natica nitida; abundant, of all ages; West Bilney and East Winch.
Pleurotoma septangularis; rare; Pentney.
Scrobicularia piperata (F. and H.); Pentney.
Mya arenaria, jun.; a fragment; Pentney.
Montacuta bidentata; Pentney.
Hydrobia ulvæ; Pentney.

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* London and Edinb. Phil. Mag., vol. vii., Jan. 1836, pp. 197-199.

† See also Mr. Trimmer's remarks on these Post-tertiary deposits of the Nar and neighbouring valley of Gaytonthorpe, Geol. Soc. Journ., vol. xvii., pp. 23 & 26.

Pullastra decussata; rare; Pentney and Bilney.
Placunomia patelliformis; rare; Pentney.
Syndosmia alba; rare; Pentney.
Buccinum undatum; rare; Pentney.
Spines of Echinus miliaris (E. Forbes)?; Pentney Warren.
Balanus; imperfect, only one valve; Pentney.
Elephas primigenius; teeth and vertebra; East Winch and Narford.
Rhinoceros tichorhinus; fragments of teeth; East Winch.
Equus caballus; teeth; E. Winch and Bilney.
Cervus elaphus; fragments of antlers; West Bilney.

Dr. S. P. Woodward, F.G.S., obligingly identified the Molluscs of this list with their recent congeners. Professor Otto Torell, of Lund, on a brief visit to me last year, recognized among these fossils several identical with those found in a similar deposit at Uddevalla in Sweden.

III. DESCRIPTION OF A NEW SPECIES OF *ACTINOCRINUS* FROM THE MOUNTAIN-LIMESTONE OF LANCASHIRE.

By JOHN ROFE, F.G.S.

AMONGST a number of Crinoidal remains collected from the Mountain-limestone near Clitheroe, in Lancashire, I found one which differs from any I have before seen, and which is believed to be new. This is as yet unique, and is now in the British Museum.

The fossil is an *Actinocrinus*, of the subgenus *Amphoracrinus*, taking M. de Koninck's view that *Amphoracrinus* is only a subgenus or group.

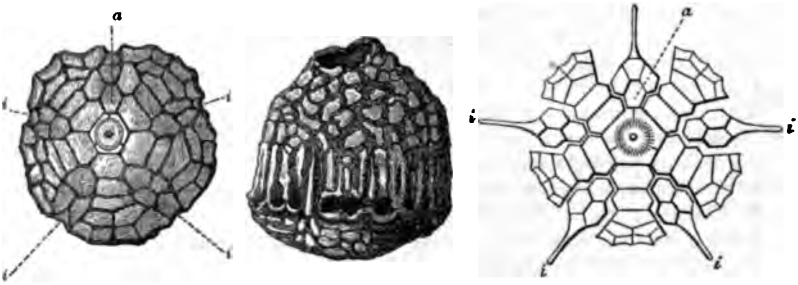

Fig. 2. View of the under-side of the 'cup.'
Fig. 1. Side-view.
Fig. 3. Diagram of the 'cup.'

Actinocrinus (Amphoracrinus) brevicalix, *Rofe*. *a, a*, anal plate. *i, i, i, i*, inter-radial plates.

The 'cup' of this species is remarkably shallow, the depth not being equal to quite one-fourth of the whole height. In this respect it resembles *Actinocrinus Atlas*, McCoy (Palæozoic Fossils Camb. Mus., pl. 3 D, fig. 5); but it altogether differs from it in other points, particularly in the arrangement of the 'radial plates;' as, in that now under consideration the first two bifurcations of these plates form part of the 'cup,' which arrangement expands the arms so much, before they spring from the 'cup,' as to leave space for only a very narrow plate between them.

The 'pelvis' or 'base' is hexagonal, tripartite, and very little larger than the attachment of the stem; aperture pentaphylloid; the first 'primary radial' is hexagonal, nearly half as wide again as long; the second 'primary' also hexagonal, about twice as wide as long; the third, or 'scapula,' as wide as the second, but cuneiform; and on each of its upper or bevel-faces there is another cuneiform or second 'radial plate,' carrying on each of its bevel-faces the first arm-plate. There are four sets of three 'interradial plates' and four 'anal plates,' besides the narrow plates between the arms. The above plates are attached to each other, and form the 'cup,' from which spring twenty 'arms.' The 'dome,' or visceral-portion above the arms, is very lofty in comparison with the 'cup.' The plates in the first row above the arms are much longer than wide, and give an appearance very different from that of any other published species of this genus, found in the Mountain-limestone; above this row the plates are smaller, and of various shapes, except the summit-plates which are similar in their proportion and arrangement to those usual in *Amphoracrinus*,—that is, one large plate at the summit surrounded by six other plates and the 'proboscis.' In the specimen here described the proboscis is broken off, and the stem and arms are unknown.

The height is 13 lines; depth of the 'cup' not quite 3 lines; diameter at the top of the 'cup' 12 lines long from the anal side to the anterior arms; transverse diameter or width 11 lines.

From the peculiar form of this fossil I propose for it the name of *Actinocrinus* (*Amphoracrinus*) *brevicalix*.

IV. ON THE EXISTENCE OF PRE-CAMBRIAN LIFE-ERAS.

By GEORGE E. ROBERTS, F.G.S., Hon.Sec.A.S.L.

THERE has been no lack, in the history of geological science, of suggestions as to how our knowledge may be advanced upon those obscure questions which yet ask for solution, both in the physical and palæontological departments of the study. Sometimes, by a surprising intellectual endeavour, we have been carried up to the moon, and asked to discover where its missing waters are, without which our useful satellite appears to be a sort of 'house to let,' —the idea having got into the mind which originated the enquiry, that the earth had appropriated the said waters for the necessities of a supposed cataclysmal epoch. Also, we have been taken down, by speculative thinkers, at divers times, to depths beneath our terraqueous surface, and asked to pin some fundamental articles of faith upon schemes which show all existing there to be either fire, or water, or a zone of meteorite-mineral, or one of solid steel, or that, nothing existing there, the interior of our planet is a vacuum. It certainly cannot be said that in either of these distinct departments of research,—studies whose materials appear to be as far removed from our use as are the 'data' derived from the hypotheses they have given birth to, from the geological laws which we at present accept, we have made any progress which can be termed 'rapid,' towards giving them a permanent place in the scheme of geological time. But there lies upon the nearest confines of the more immediately terrestrial study, a certain kingdom of research into which some few honest and earnest workers have been of late casting lines of scientific enquiry. And as this study, which up to a very recent date might have been designated as one quite outside the domains of palæontology, does not require the aid either of a balloon, or a diving-bell, or a chain and windlass of unknown length and power, but may be entered upon with the ordinary appliances of a geological observer, to wit, certain tools of the smithery, good eyes, and a patient temper, I may, probably, be allowed to popularize somewhat the position of the rock-material necessary to it.

Once upon a time, all granite-rocks were considered to be of the same *pre*-anything age. That idea, of course, is exploded now; but I believe that I may really say that (saving the simple acknowledgment put forth in our latest manuals, that 'granite may be of any age') the alteration in high geological quarters respecting the age and condition of other rocks, allied in the old text-books with granite, such as syenites, hornblendic schists, tourmaline-bearing felspars, and felspathic rocks generally, is as yet either unknown, or at least not so known that it may be turned to scientific and useful account by the majority of our field-working geologists—the source, in so many instances, of new and valuable lines of geological enquiry. When, last year, and again in the July of the present one, I examined a large series of rock-specimens obtained from the cuttings on the line of the Mid-Scottish Railway (from Perth to Inverness), I was greatly struck with the petrological value of the series of specimens of gneissic and other metamorphosed rocks so exposed. The specimens which I obtained comprised some of rocks previously unknown in Britain. Probably the best term to designate them by would be tourmaline-bearing felspars, with a tendency to become gneissoid. But it is difficult to express by any term, however complex, the aspect of a rock which, in a single hand-specimen, exhibited thirteen different minerals. As far as I know, no rock has been found presenting any natural alliance with them nearer than Norway and Finland on the east and Canada on the west. But these natural equivalents, in position and mineralogical character, are very valuable to us as indicative of relationships. And when, as the question broadens, the so-called syenites of the Malverns claim, through the investigations of Dr. Holl, a place in the scheme which I am about to draw for the pre-Cambrian age, and also the rocks, so irregularly presented, of Charnwood forest ask for recognition, I think I may reasonably draw the attention of those geologists, more happily situated than myself for purposes of investigation, to the question, *How much of life-bearing time can be con-*

ceded to eras beyond the 'Cambrian'?[*] The question is not now whether any evidences of life have been found, because that has been already most satisfactorily settled by Sir W. E. Logan; nor yet does it depend on any boundary arbitrarily fixed between the Lower Silurian, Cambrian, or Huronian; it is rather a question of the extension of those or of other forms of 'Fundamental Gneiss' or 'Laurentian' life. For it cannot be supposed that the gigantic foraminifers of the Canadian Loganite-rock will long stand alone in the catalogue of what, as yet, may be termed primæval life.

Let our primitive mountain-chains be examined minutely for their contained layers of altered limestone or serpentine, for I am convinced that rocks of such characters are to be met with in many hitherto unsearched parts of Britain, and who shall say that life-relics may not be obtained from them? Markings which to the unassisted eye appear but as blotches and stains, may be, by microscopical aid, resolved into evidences of life more ancient than any yet detected in Britain. Sir R. I. Murchison, whose sagacity led him to place the fundamental gneissic and other rocks of the Western Isles beneath all life-bearing rocks in Britain, has opened out a new kingdom of research; and the note of pilotage which has been sounded from the probably still more ancient kingdom of Laurentia has an assuring sound, telling us that, though unseen rocks may lie in the way of our ventures into the unknown sea, they are those which will aid us in our search, and probably reward us with the objects for which we seek. I would suggest, therefore, to those specially interested in Palæozoic geology, that it would add greatly to the success of the enterprise, if the subject were noticed monthly in the GEOLOGICAL MAGAZINE by contributions, however small, from those who are able by proximity to mountain-chains of undoubted or suspected 'Cambrian' or pre-Cambrian age, to search narrowly into the mineralogical character of the rocks composing them. Such notes should also contain the petrology of the hills thus studied, and, when possible, chemical analyses of the rocks, carried out on the plan adopted by the Rev. Mr. Timins, in his analyses of the Malvern syenites, in which range Dr. Holl has obtained clear evidence of stratal deposition. We greatly need in England the labours of men like my venerable friend Dr. Nils Nordenskiöld, of Frugard, who, with the aid of his son, Prof. Adolph Nordenskiöld, of Stockholm, has chemically and mineralogically analysed almost every Finnish and Scandinavian rock, a nearly complete series of which I had lately the pleasure of receiving from him. Such labours cannot be too highly appreciated by palæontologists, for chemically altered palæozoic rocks are very suggestive of fossils. Perhaps it is not too much to say that Sir W. Logan's discoveries have quite disposed of the term 'Azoic,' as applied to any rocks, save those erupted beyond all question from volcanic sources.

In conclusion, it may be well to offer for the refreshment of our insatiate minds, a brief statement how far back an 'ancestral' lineage has extended, zoologically and stratigraphically, in order of time. Though it is not an easy task for any geologist to arrange chronologically the sedimentary deposits between the lowest accepted Silurian and the zone at which all differences of opinion cease as to the existence of life, merely because we have, as yet, in Britain discovered no trace of its existence. But confessedly there is an enormous lapse of time between these two limits; and, as an undoubted discovery of life-remains has been made, very nearly upon the lower confines of the older series of strata, we may reasonably ask for search—a constant and active search—into rocks of ages intermediate in time.

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[*] I use the term 'Cambrian' in designation of certain pre-Silurian rocks described by our English Nestor, Professor Sedgwick, and to which may be referred the 'Primordial zone' of the Paradoxides-bearing rocks of St. David's.

In the Longmynd rock, suggested to be of Cambrian age, near Church Stretton in Shropshire, Mr. Salter discovered some traces of vermicular life (Worm-burrows, 'Arenicolites') and a fossil organic relic, supposed at first to belong to a Trilobite, but since discovered to be a part of the shelly covering of the extinct phyllopodous crustacean, *Ceratiocaris.* Several other endeavours have been made since to discover more, or even a correspondent fragment, of this ancient shrimp-like Crustacean; but even a pilgrimage undertaken by Prof. Morris and myself to the classical spot, to which we were guided by Mr. Marston, of Ludlow, failed; for, although we broke a few hundredweights of the shaly stone of the mountain, no remains of the ancient crustacean rewarded our labour. Still I am convinced that at some future time the swelling hills of the Longmynd will disclose, to geologists who can spare more time to their investigation, a more satisfactory account of those relics of ancient life which they undoubtedly contain.

Here, then, studies open out to us which will repay those who take them up; for what can be a grander thought for an enthusiastic field-geologist, who looks upon a mountain which he has formerly considered as of 'granitic' or 'azoic' age, than that such a monument of the world's existence contains, close-treasured within its rocky bounds, evidences of a more ancient life-light than that which had previously illumined the confines of his knowledge?

ABSTRACTS OF FOREIGN MEMOIRS.

On Brackish Waters and their Deposits. By Dr. Lorenz. (Proceed. Imp. Acad. Vienna, Dec. 10, 1863.)

According to Dr. Lorenz's observations in the Adriatic, especially at the mouth of the Fiumara, fresh water poured into a tideless sea, somewhat deep near the shore, forms a rather limited brackish stratum spreading over the salt water in form of a wedge, the lateral planes of which at first converge in a steep and subsequently in a very acute angle. At the mouth of the Fiumara, the horizontal extent of this wedge is to its initial vertical altitude as 700 to 1. The conditions at the mouth of the Elbe are quite different; this river flowing into a sea shallow throughout, and regularly stirred to its bottom by very violent tidal currents. In the summer of 1863, Dr. Lorenz, having ascertained the specific gravity of water taken in different depths at fifty points along a line of nine geographical miles from Neuhaus to Heligoland, states with confidence that there is no brackish stratum spreading over perfect sea-water at the mouth of the Elbe: the brackish water, gradually passing into completely salt water, extends to the sea-bottom. The water here, however, taken as a whole, is divisible into a system of obtuse wedges; so that constantly a wedge of fresh water, with its edge turned seaward, is sliding over a wedge of somewhat more saline water. The components (length, thickness, and angles of convergence of the lateral planes) of these wedges, when construed by means of average values for any fresh-water current, may serve as a basis for an empirical formula, by the aid of which (the transversal section and velocity of this current, the depth and shape of the marine basins into which it flows, and the nature of the tides in it being known), the dimensions of the bulk of brackish waters and the distribution of salinity in them, may be approximately determined. Besides the physical interest connected with them, such determinations are highly interesting, in respect to their influence on the distribution of both living and fossil organic beings.

Count M.

On the Liassic Crinoidal Limestone of Freiland, Inbach-Graben, and Grossau, Lower Austria. By Professor Peters. (Proceed. Imp. Geol. Institut. Vienna, March 15, 1864.)

The limestones of the first two of these localities, closely allied to the Hierlatz-strata of the Eastern Alps, contain *Rhynchonella furcillata*, Theod., *Waldheimia Lycetti*, Dav., *Terebratula subovoides*, Roem., *Rhynchonella Moorei*, Dav. (a species of the West-European Lias, also found lately in the Banat), *Rh. tetrahedra*, Sow., *Rh. calcicosta*, Quenst., variously shaped and partly gigantic *Spiriferinæ*, of the type of *Sp. rostrata*, Schloth., mixed with species characteristic of the Hierlatz-strata. The limestone of Grossau, chiefly composed of *Pentacrinus basaltiformis*, lies between Carboniferous Gresten-strata and an extensive series of Liassic variegated marls. Among the seven species of Brachiopods occurring in it, three correspond to those of the Hierlatz-strata, and two or three are Extra-Alpine forms, far spread in the Middle Lias of Germany and North-western Europe. All the three localities are consequently intimately connected with the Middle Lias of the Extra-Alpine regions; and may point to the conclusion, that the Limestone of Hierlatz also is not an absolute equivalent of the Lower Lias. The discrepancies between the Alpine and the Extra-Alpine Liassic deposits may be explained by the geological perturbations which influenced the Southern and North-western German Lias and their faunæ, as also by immigrations from the Eastern faunæ under the influence of marine currents, dependent on the extent and conformation of the coast.—Count M.

ON THE DISCOVERY OF THE PELVIS OF *DINOTHERIUM*; AND ON THE AFFINITIES AND HABITS OF THE GENUS. By the Rev. J.-M. SANNA SOLARO.*

M. SANNA SOLARO has discovered, at Escanecrabe, Dép. Haute-Garonne, a pelvis of a *Dinotherium*, a portion of the animal hitherto unknown: its weight is 160 kilogrammes (352½ lbs.). M. Lartet, who also has examined the specimen, is of opinion that it belongs to a species of much larger dimensions than *D. giganteum*. The diameter of the pelvic arch is 1·8 metres (nearly 6 feet); the height 1·3 metres (4 ft. 3 in.). Certain peculiarities of form, and its colossal dimensions, must modify our ideas regarding the size and habits of this animal.

M. Solaro compares the pelvis of his *Dinotherium* with that of the Elephant, Tapir, and Megathere, with which it has some affinities; but it presents also many points of difference. Besides the strange conformation of the pubic bones, sufficient alone to distinguish it at a glance from all other pelves, there is a remarkable peculiarity, not known in any other animal,—namely, a triangular depression at the side of the cotyloid cavity, and between it and the lower projection of the iliac bones. In this depression there was found a bone which certainly formed an articulation. The corresponding depression of the other part was wanting; but there occurred at the side of the pelvis another and more complete bone, though perhaps not entire. The head of this bone is triangular, and its dimensions correspond with those of the aforesaid depression. M. Solaro regards this bone as indicating a *marsupial* affinity, though it is true, that among other Didelphic Mammals, the marsupial bones are not articulated to the ilium; but it is to be borne in mind that the head of the *Dinotherium* differs remarkably from that of Proboscidians and other animals, and there is no reason why the marsupial bones should not be articulated to the ilium instead of to the anterior part of the pubis.

If, then, the *Dinotherium* was an aplacental mammal, its habits could not be those assigned to it by Dr. Buckland, namely, habitually living and feeding in lakes, and occasionally frequenting their margins. In the first place, it could not live in the water, at least during the second period of gestation, without exposing its young to injury; and, as from the long time the young are carried in the pouch (in the Kangaroo, an animal of diminutive size in comparison, it is eight months), the animal would have to habituate itself to other than its ordinary kind of nutriment. Secondly, the author is of opinion that a lacustrine vegetation would be inadequate for the supply of food for such a gigantic animal; and he adds that we have a further evidence of this in the conformation of its teeth,—for, from the nature of the tissues of the roots of aquatic plants, a very slight effort would be sufficient to triturate them; but the deep grooves and trenchant ridges of the grinders of this animal indicate, on the contrary, that the vegetables upon which the animal browsed offered a greater resistance than would be presented by the root, stems, and leaves of lacustrine plants.

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* Mémoire sur le Premier Bassin de *Dinotherium* découvert dans le Département de la Haute-Garonne par le R. P. J.-M. SANNA SOLARO, de la Compagnie de Jésus. Large 8vo. Toulouse, 1864. pp. 19. 3 plates. See also 'L'Institut,' Oct. 5, 1864, p. 319.

The author is inclined to believe that, like the Elephant, the *Dinotherium* used its tusks as offensive and defensive weapons, and especially to break down and to hold up branches, so as to enable it to reach with its trunk the tender growths of the trees, which were probably its food; and that they further served to effect a passage through the underwood of dense forests. The neck of the animal was very short; and the trunk must have been of great length, and was used, probably, for putting the young into the pouch, as well as for getting food.—R. T.

Photography applied to Palæontology. (Specimen Photographicum Animalium quorumdam Plantarumque Fossilium Agri Veronensis. Dr. A. B. Prof. Massalongo descripsit. Mauritius Lotze photographice expressit.) 4to. p. 101. 40 plates. Verona, 1859.

IN this work Professor Massalongo has described, and M. Lotze photographed, 2 species of Ophidia, 12 Fishes, and 8 Acotyledonous, 2 Monocotyledonous, and 23 Dicotyledonous Plants. The descriptions of the genera and species are given in Italian and Latin in parallel columns. The specimens described are all from the rich Eocene deposit of Monte Bolca, abounding in Fish- and Plant-remains, and from which some fossil Snakes have also been obtained. The delicate cream-coloured matrix offers such a strong contrast to the bright rich iron-stained fossil-remains that a better series to submit to the art of the photographer could hardly have been chosen. Every minute bone in the skeleton, and every fin-ray of the Fishes can be clearly seen; but the Snakes do not print at all well, little more than a black outline of their forms being preserved. Among the Fishes: *Platax Plinianus*, Massal., *Semiphorus velifer*, Agass., 2 sp. of *Acanthurus*, *Scatophagus frontalis*, Agass., *Ephippus longipennis*, Agass., *Pychnodus gibbus*, Agass., and among the vegetable remains, *Araucarites Venetus*, Massal., *Getonia Bolcensis*, Ung., *Sterculia prisca*, Massal., and 2 sp. of *Dombeyopsis*, are excellently reproduced. Some of the leaves and other plant-remains are not so satisfactory, and we must still admit our preference for good lithographic plates.

REVIEWS.

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On the Geological Position and Age of the Flint-implement-bearing Beds, and on the Loess of the South-east of England and North-west of France. By Joseph Prestwich, F.R.S., F.G.S. (From the Philosophical Transactions, Pt. II. 1864.)

IN the earlier days of the study of Geology in this country, the attention of observers was, as might have been expected, principally directed to the vast successive formations of which the crust of the earth is composed, in order to establish the stratigraphical relation of the various beds, and to determine the nature of the organic remains by which they are characterized. The more recent, and especially the surface-deposits, were, comparatively speaking, neglected; and, though by the more far-seeing the existing operations of nature were studied as throwing light upon the method of formation of ancient deposits, yet there appears to have been a sort of latent feeling that a patch of gravel on a common, or a brick-field on a hill-side, were subjects altogether too superficial for the researches of a geologist. Or if, even, by the finding of mammalian bones or testaceous remains in them, these deposits were obtruded upon his notice, they stood a fair chance of being referred either to the Noachian deluge or to a wash of the sea over the land, or to some mysterious cataclysmic action.

Of late years, however, the extreme interest of the beds connecting the Tertiary Period with the existing state of things, and more especially those containing the remains of a fauna so closely allied to that of the present day as the Postpliocene, has been keenly felt, and much time has been devoted to their study by many of our leading Geologists, and particularly by the author of the present paper. The discovery of flint implements, wrought by the hand of man, in the gravels of the Valley of the Somme and elsewhere, which formed the subject of a memoir by Mr. Prestwich communicated to the Royal Society in the spring of 1859, added no little zest to these researches, and has greatly multiplied the number of those engaged in pursuing them. It is needless to do more than allude to the numerous books, pamphlets, and papers which have been written on the subject of the Antiquity of Man, to show the general interest that has been taken in these discoveries; and we therefore proceed at once to call attention to some of the salient points of this last most valuable contribution of Mr. Prestwich, the title of which stands at the head of this notice, and which originally consisted of two separate communications to the Royal Society, though they are now incorporated together.

The various drift-gravels which occur along river-valleys, or capping the hills at their sides, have been regarded by different writers, first, as of marine origin; secondly, as due to cataclysmic action; and, thirdly, as of fluviatile origin; and Mr. Prestwich, after briefly citing some of the authors who have assigned them to these different causes, and stating the difficulties he felt in referring the excavation of existing valleys to the operation of rivers upon their present scale, or to cataclysmic action, thus states his own views:—'I could not admit the possibility of river-action, as it now exists, having in any length of time excavated the present valleys and spread out the old alluvia; neither was it possible to admit purely cataclysmic action in cases where the evidence of contemporaneous old land-surfaces and of fluviatile beds were so common. But with river-action of greater intensity, and periodical floods imparting a torrential character to the rivers, the consequences of the joint operation are obtained, and the phenomena admit of more ready explanation.'

These views are based on a careful examination of a large number of river-valleys, and especially of the numerous localities where flint implements have now been found in beds of undisturbed fluviatile gravel. The Valley of the Waveney at Hoxne, the Valley of the Lark at Icklingham, that of the Ouse at Bedford, the deposits near Reculver and Whitstable, the Valley of the Somme near Abbeville and Amiens, that of the Seine near Paris, and that of the Oise near Creil are all passed under examination; and, had the deposits near Salisbury and on the shores of Southampton Water been known as productive of flint implements at the time when this paper was written, the evidence afforded by them would no doubt have been adduced as corroborative of that of the other cases. The testimony afforded by the lithological examination of the valley-gravels amounts to this, that all the materials of which they are formed can be referred to rocks or to older drift-deposits traversed by the valleys or their tributaries; and that in no instance can the direct introduction of any foreign element be proved. The necessary deduction is that the transporting agent by which the mass of materials composing the gravel has been brought to its present position, must have been in each case limited in its operation to the same hydrographical basins as those drained by the present rivers.

This point is well illustrated by a sketch-map, showing the source and distribution of some of the Quaternary Valley-deposits of parts of England and France, which exhibits at a glance how and why in the Valley of the Seine, for instance, pebbles of the granitic and porphyritic rocks do not occur in its gravels until after its junction with the Yonne, which brings them down from the Morvan; and how and why in the Valley of the Oise pebbles of the palæozoic strata of the Ardennes occur; while in the Valley of the Somme, the watershed of which is in part conterminous with that of the Oise, such pebbles are entirely absent.

The valley-gravels are divided by Mr. Prestwich into two classes, the 'high-level' and the 'low-level;' not that it is possible to draw any exact line of demarcation between them, as the one sometimes shades insensibly into the other. Still they are the two 'extremes of a series marking a long period of time, and probably formed under analogous but not identical conditions.' 'The broad distinction consists in one being on hills of various heights flanking the valley, while the other occupies the immediate river-valley, always following its main channel, and constantly rising on its sides to the height of several feet, or where the valley is broad, forming low terrace-platforms on its sides.' They represent, in fact, portions of the drifted matter accumulated in the beds of the rivers at a time when they ran at a higher level than at present, and which happen to have been left undisturbed by the stream during their farther and subsequent excavations of their valleys. That the high-level gravels, sometimes 100 feet and upwards above the levels of the present rivers, and on the flanks of valleys a mile in width, were deposited by river-action, is abundantly proved by the presence in them of fluviatile shells; while their elevation, so far above the reach of any floods of the present rivers that can possibly be conceived, proves that the valleys must, in great part at all events, have been excavated since the high-level gravels were deposited. The evidence of the Loess, or brick-earth, is also of importance in the case; for this deposit occurs associated with the high-level gravels, and has all the character of the fine silt or sediment deposited in places where the flood-waters, out of the direct channel of a turbid stream, remain for a time in a state of comparative repose. It contains, too, numerous land shells, occasionally intermixed with a few fresh-water species. Nor is this purely fluviatile character confined to the gravels and loess of the higher level, but extends to those of the lower level also. The whole phenomena, indeed, are in general such as might have been theoretically assigned to valleys formed by the erosion of rivers subject to periodical floods, though there are particular circumstances which tend to show that the erosive power may have been greater during one part of the process of excavation than during another.

One feature in the case is that in the high-level valley-gravels large boulders are of not unfrequent occurrence; and there is an irregularity, confusion, and general want of stratification in the beds, which are also often contorted. Some of these boulders or blocks are as much as 8 feet by 3 feet in dimensions; and in some instances, as in the Valley of the Waveney, where there are no hard rocks to furnish boulders, but the valleys traverse a Chalk district, large masses of flint, with sharp and intact angles, are common. The contortions, which are perhaps nowhere better seen than at St. Acheul, near Amiens, are such as sedimentary beds could never have assumed in a process of deposition by the mere action of water. In the low-level gravels, these contorted strata are generally absent; and, though large blocks are often common in them, yet they are generally more worn than in the upper gravels. The low-level gravels also usually present a more uniform bedding, and a greater abundance of beds of sand and fine gravel, with oblique lamination.

Looking now at the Fauna and Flora of the high-level beds, Mr. Prestwich finds that, out of 109 land and fresh-water shells now inhabiting the South of England and the North of France, 36 species have been found in the flint-implement-bearing high-level gravels. Taking the group as a whole, it appears to have a wide range, but one more in a northern than in a southern direction; for whereas only 29 out of the 36 species are found in the plains or on the hills of Lombardy, no less than 34 range to Sweden, and 31 to Finland, a country in which only 77 species have been recorded. A great number of these molluscs occur also in Siberia, for which country, however, there is no complete list of the land and fresh-water shells. The mammalian remains are at present confined to *Elephas primigenius, E. antiquus, Equus, Bos,* and *Cervus*, among the latter possibly *C. Tarandus.* Of these the Mammoth and woolly haired Rhinoceros appear to have inhabited countries possessing cold climates, while the Horse and Ox brave the winters of Siberia and North America, and the Reindeer appears to be essentially a northern animal. Of the flora of the high-level period, but little is known;

but at Hoxne, the Oak, Yew, Fir, and possibly Bilberry, have been found.

Taken together, the organic remains, though not affording decisive evidence of the character of the climate at the time of the deposit of the high-level gravels, show a balance in favour of the probability of a climate severer than at present in the same latitude, though not of extreme rigour. It must have been a climate in which the Oak, Yew, and Fir could thrive; where the Reindeer lived; and where the Deer, Horse, and Ox abounded; but where the rivers were subject to periodical floods; where they froze, so as to be able to transport the large boulders already mentioned; and where the ice 'packed' in sufficient quantities to produce contortions in the beds, such as already described; for in the same way as the contortions in the clay cliffs of Norfolk have by Mr. Trimmer and Sir C. Lyell been attributed to the grounding of icebergs, so is Mr. Prestwich disposed to attribute to a somewhat like action of the river-ice, on a small scale, the analogous structure exhibited by the St. Acheul and other high-level gravels.

Turning now to the low-level gravels, we find in them an increase in the number of species of land and fresh-water molluscs, which are here 52. This group also maintains a slightly northern aspect; as, out of the 52, 42 are now living in Sweden, and 37 in Finland. It comprises, therefore, nearly one half of the Finnish species; whereas only one fifth of the Lombardic species, or 38 out of 193, occur in the beds. At Menchecourt, near Abbeville, some marine and estuarine shells occur; among them, *Littorina squalida*, which has now retreated to the coast of Norway, and *Tellina Balthica*, which is a northern variety. Of the fresh-water shells, *Cyrena fluminalis* deserves especial mention. It is now only found in the Nile and in mountain-streams of Central Asia—a range presenting great extremes of climate. Among the mammalia we now find *Hippotamus major* and *Felis spelæa*, which at first sight seem to militate against the theory of the climate of the period having been severe; but, as Mr. Prestwich observes, 'like its congeners, the Elephant and Rhinoceros, this Hippotamus belongs to an extinct species, and it becomes a question whether, like them, it may not have been adapted to endure the rigours of a severer climate than the living species of these genera can now endure.' As to the Tiger, there is at the present day a species common on the lower Amoor, where the river is frozen five months in the year. The flora of the 'low-level' period is confined to a solitary specimen of *Chara*; so that the premises from which to draw conclusions as to climate are limited. Still, on the whole, Mr. Prestwich considers that the evidence is in favour of its having been rather less severe than that of the previous high-level-gravel period.

In a former paper he has shown that these high-level gravels are in their turn newer than the Boulder-clay of England and the period of extreme cold marked by the great extension of the European glaciers; and he here goes on to show how well the phenomena observable in the valley-gravels agree with a climate in which the winter-temperature was at first considerably lower than at present, but the severity of which was being gradually mitigated. The volume of water that there must have been in the old rivers (which, it will be remembered, had no greater gathering ground than their representatives of the present day) to spread out such masses of coarse shingle may be safely assigned to the greater winter-accumulation of ice and snow, which must of necessity have accompanied a greater degree of cold, and which by rapid thawing in the spring- or summer-months would periodically cause immense inundations; while the transported blocks, scattered indiscriminately through the gravel, and often associated with delicate and fragile shells, and with mammalian bones but little if at all rolled, can hardly be referred to any other action than that of ice, to which also the contortions in the gravels already mentioned appear to be due. The excavating powers of rivers in such a climate would, owing to the torrential character imparted to them by the summer-thaws, be far greater than at present, even were the rain-fall the same; but it is by no means improbable that, in the neighbourhood of the sea, the greater cold would be accompanied by a greater precipitation of rain or snow.

But besides the mere excavating power of the running water, Mr. Prestwich calls to his aid the operation of ground-ice (which he shows to be a powerful transporting agent), and the effects of alternate frosts and thaws in breaking up masses of rock, and of the solvent powers of rain and snow-water. And he further invokes the assistance of the gradual upheaval of parts of England and France, of which we have some evidence in the raised beaches which in places fringe the shores.

Into all these questions we have not space to enter; but we think we have said enough to show the interesting character of this Paper, and to give some idea of the array of facts on which Mr. Prestwich's theory is based. It will be seen that, while he entirely abjures the cataclysmic theories still held with regard to these river-gravels by so many French geologists, he is reluctant to attribute the entire excavation of the valleys to causes operating with no greater intensity than they do at the present day. Yet we think that the 'Quietist' need hardly regard such views with distrust, nor the 'Catastrophist' hail them with satisfaction as supporting his opinions. For after all, granting, as there seems no reason to doubt, that we had in this part of Europe at the commencement of the Post-pliocene period an Arctic temperature, it is evident that during the transition from such a temperature to that which prevails at the present day, there must have been a time when conditions such as those which Mr. Prestwich describes prevailed, and during which the ordinary excavating forces of rivers must, in the course of Nature, have operated with greater intensity than at present. It appears to us not impossible that the excavation of the valleys above the line of the high-level gravels containing organic remains, and which Mr. Prestwich seems inclined to attribute in some measure to the action of the sea during the emergence of the land from beneath it, may have taken place during such a subglacial period. At all events, if the land were above water at the time, erosion, and that on no slight scale, must probably have been going on; and in the Valley of the Somme there are gravels at a higher level and older than those of St. Acheul, which may possibly belong to such a period. Indeed, Mr. Prestwich himself refers to some high-level gravels which must have been formed before the country became inhabited, and which would therefore also be unfossiliferous.

As to the time required for the excavation of the valleys even under the most favourable conditions for it consistent with the existence of the animal life, the relics of which are found in the gravels, Mr. Prestwich is judiciously cautious in expressing an opinion. We cannot do better than quote his own words upon this point:—'All these phenomena indicate long periods of time. I do not, however, feel that we are yet in a position to measure that time, or even to make an approximate estimate respecting it. That we must greatly extend our present chronology with respect to the first existence of man appears inevitable; but that we should count by hundreds of thousands of years is, I am convinced, in the present state of the enquiry unsafe and premature. Nevertheless, just as though ignorant of the precise height and size of a mountain-range seen in the distance, we need not wait for trigonometrical measurements to feel satisfied in our own minds of the magnitude of the distant peaks, so with this geological epoch, we see and know enough of it to feel how distant it is from our time, and yet we are not in a position at present to solve with accuracy the curious and interesting problem of its precise age.'

As containing some elements for the approximate estimate of the duration of time, Mr. Prestwich calls attention to one or two points besides the mere changes in the configuration of the surface and the alteration which has taken place in the mammalian fauna. Our space, however, precludes more than a mere mention of them. One of these is the character of the cylindrical or funnel-shaped gravel- and sand-pipes which occur in most calcareous rocks, and which are in all probability due to the infiltration of water charged with carbonic acid. Several of these pipes occur along the Valley of the Somme under conditions which prove that they must have originated since the first emergence of the high-level gravels above the old river-bed; and, could a rate of progress be assigned to their erosion, these would give a good gauge of time. One of them, near Drucat, must be nearly 100 feet in depth; and M. Boucher de Perthes possesses flint implements reported to have come out of the gravel contained in the pipe. On the slope of the valley of the Escardon, close by, is a bed of travertin or calcareous tufa, which commences 70 feet above the present level of the stream, and testifies to a period when the valley had not yet been excavated, and the water in the pervious beds of Chalk could find no lower vent. Another method suggested bears reference to the probable perturbations in the increment of heat at different depths in consequence of the refrigeration of this part of the surface of the earth at the Glacial Period, of which it seems possible some trace might be left to the present day. But into this question, and that, whether the refrigeration was general or only partial, we need not enter. We hope that we have said enough to induce our readers to consult Mr. Prestwich's excellent memoir for themselves. They will find in it a careful and detailed exposition of facts: and the theories based upon them are evidently the result of long and careful reflection; and, though on some minor points there is sure to be a difference of opinion, yet the main argument, as to the process of excavation and the length of time necessarily involved in it, will, we are confident, eventually meet with general acceptance, even if the rising school of geologists, who have no longer 'the chill of poverty in their bones' may be induced to draw more largely than Mr. Prestwich upon the enormous balance of past time which stands in their favour in the Book of Nature.

LES CONSTRUCTIONS LACUSTRES DU LAC DE NEUFCHÂTEL. Par E. DESOR. Neufchâtel, 1864.

THE Lake of Neufchâtel is remarkable, even among the Swiss Lakes, for the number and variety of the ancient remains which have been found in it; and Professor Desor is remarkable, even among the Swiss archæologists, for the care with which he has studied them. While the lakes of Eastern Switzerland contain villages of the Stone Age only, and those of Western Switzerland of the Stone and Bronze Ages, the Lake of Neufchâtel, besides many villages belonging to the last-mentioned periods, contains also almost the only station which has yet been discovered, referable to the Age of Iron. Thus, the memoir by Professor Desor, confined though it is to the antiquities of this one lake, contains, in fact, an epitome of the whole subject.

Commencing with the Age of Stone, he remarks that the piles are generally much larger than those used in later periods; and that, instead of projecting into the water, they are in most cases worn down by the action of the waves, to the level of the stones by which they are surrounded. These stones form slight elevations at the bottom of the lake, and are known in Switzerland under the name of 'Steinbergs.' It is evident that, unable to drive their piles into the bottom of the lake, the early people heaped stones up round the piles, and thus kept them in a perpendicular position. In other lakes, of which the bottom is soft, they have been able to drive the piles sufficiently deep to keep them upright. As yet, in the Swiss Lakes only two skulls have been found which can, with any reasonable probability, be referred to the Stone Age; one by M. Messikommer, at Robenhausen, the other at Meilen, on the Lake of Zürich. The former has not yet been described; the latter exactly resembles those found at the Bronze Age station of Auvernier. As regards the axes of nephrite, which have been supposed to indicate a commerce with Asia, Professor Desor suggests that the material may have been obtained from the conglomerate known as the 'Nagelflue.' He does not, however, actually state that any fragments of this interesting substance have yet been discovered in that deposit.

The white coral, found at Concise, and the bit of amber from Meilen, may have, in reality, belonged, he thinks, to the Age of Bronze.

Turning now to this later period, Professor Desor remarks that the lake-villages are generally situated at a greater distance from the shore, and, consequently, in deeper water. The piles are thinner, and are often of split wood; they project above the mud to a height of from one to two feet. The pottery of this age, though prepared in the same manner as that of the preceding period, is less coarse, and the forms are more elegant. The most characteristic objects of the lake-villages of the Bronze Age are, however, personal ornaments; such as earrings, amulets, bracelets, hair-pins, &c. These are often in a beautiful state of preservation, and were apparently quite new when dropped into the water. Professor Desor is disposed, from this circumstance, to think that the pile-buildings were magazines, rather than dwellings. Whether this was the case or not, it is certain that some, at least, of the dwellings in the Bronze Age were situated on dry land. One of these has been found at Ebersberg, in the canton of Zürich. In addition to the evidence of an extensive commerce, afforded by the bronze itself, Professor Desor refers, as a proof of the high civilization existing at that period, to the amber beads, which must have come from the Baltic, to a bead of blue glass, found at Auvernier, and to the general elegance of the above-mentioned personal ornaments.

The only lake-village of the Iron Period yet known, is that of the Tene. The piles resemble those of the Bronze Age stations; but the objects found among them are entirely different. Iron swords, differing in form, as well as in material, from those of the preceding period,—pottery resembling that which we call Roman, but referred by Professor Desor rather to the Etruscans, and coins, for the first time make their appearance. The ornaments are less numerous, and of a different character. There are no rings, no earrings, and but a single hair-pin, which is of bronze, and may after all belong to that period. Moreover, the objects of bronze are hammered, and not cast, as is invariably the case with those which truly belong to the Bronze Age. The coins belong to the true Gaulish type: they have a man's head on the one side, and a horned horse on the other. Neither the coins, however, nor the other objects found at the Tene, show the slightest trace of Roman workmanship.

In conclusion, Professor Desor has a chapter on the antiquity of these lake-remains, which he refers, as we think, correctly, to a period anterior to the rise of Roman power. He mentions, with just praise, Professor Nilsson's able work on the Bronze Age, agreeing with him in the opinion, that traces of the Phœnicians are to be found as far north as the shores of Norway. Professor Desor, however, rightly concludes that the facts do not, as yet, warrant any more decided inference, and that they clearly indicate that the Phœnician commerce in the North belongs rather to the Age of Iron than to that of Bronze.

ON SOME INDENTATIONS IN BONES OF A *CERVUS MEGACEROS* FOUND IN JUNE 1863, UNDERNEATH A BOG NEAR LEGAN, COUNTY OF LONGFORD, IRELAND. By J. BEETE JUKES, M.A., F.R.S. Dublin, 1864. pp. 11; with 4 Plates.

THE object of this memoir, read before the Geological Society of Dublin, December 9, 1863, is to describe certain distinct indentations, abrasions, and other markings, visible on some bones of *Cervus megaceros* (often called the Gigantic Irish Elk or Deer), found in shell-marl (2 or 3 feet thick), on gravelly clay, and under peat, once probably 40 feet thick. The skull, fragments of antlers, and upwards of 40 bones of the skeleton were secured. Of these, the left femur shows 'a deep transverse gash across it,' on the inner-side, above the knee-joint, and two small 'circular holes, like nail-holes' near by; the right tibia has a broad shallow transverse indentation, exactly fitted by an equally indented antler-tine; and there are three small shallow notches on the polished surface at one edge of the tibia. There are also some abrasions at both ends of the femur, and at the upper end of the tibia. All these markings (which appear to have been on the bones when found) are very clearly described, and illustrated by careful drawings. They were, of course, at once regarded as artificial, and as evidence of man's co-existence with the now extinct *Cervus megaceros*; but Mr. Jukes thinks that they may be accounted for otherwise.

He observed that the indented antler-tine and tibia not only closely fit together, even to minute crevices being filled by little opposite ridges, but the surfaces of the two corresponding hollows are similarly stained with irony streaks; and he thinks that not only were these two bones not fitted together by human hands, but have been mutually indented by pressure one on the other under the heavy peat. He observes that, even if we suppose these bones were once roughly fitted and tied together (the notches on the edge of the tibia, in such case, corresponding to the marks of withes) the difficulty arises as to their having been imbedded with the rest of the skeleton, which seems to have found its resting place in the shell-marl just as the many drowned and drifted carcasses of Deer and other animals did in the old lakes.

The notched and bored femur has especially the look of having been artificially cut, the sides of the notch seem to have been hacked 'by the sawing action of a knife;' 'the bottom of the cut terminates in an acute angle;' and the cells of the bone are not all crushed. A small piece of antler, however, was impacted in the gash; and Mr. Jukes thinks that this indentation might have been formed by pressure against a contiguous antler-point. The author offers, also, some observations on the analysis of the bones, on the usual conditions of such bones found in the bogs of Ireland, and on the frequent occurrence of indentations and abrasions on the bones of *C. megaceros.*

If the bones in question were cut by man before they were imbedded in the marl, it must have been when the valley was occupied by a lake, before the formation of the peat, which, 30 or 40 feet thick and 50 square miles in extent, must have taken several thousand years for its accumulation. This consideration, and the possibility of the bones having been naturally abraded, together with the fact 'that the *Cervus megaceros* was the contemporary of the Mammoth or Woolly Elephant, the Woolly Rhinoceros, the Cave-Hyæna, the Cave-Bear, and the Cave-Lion, and a species of Hippopotamus, all now extinct,' as well as of the Reindeer, the Brown Bear, the Polar Bear,* and other creatures now extinct in Ireland, make it difficult to Mr. Jukes to accept these apparently incised bones as evidence of their contemporaneity with Man in Ireland, although proofs of such high antiquity for the human race have been brought to light in England and the Continent. At all events the memoir shows good reasons for extreme caution being taken whenever scratched, drilled, notched, and otherwise abraded and indented fossil bones are brought forward as evidence of man's handiwork, even without taking into consideration the many other natural methods, such as wear and tear by gravel with or without ice-action, partial decomposition, gnawing by rodents, &c., by which such markings may be made.

ON THE MAGNESIAN LIMESTONE OF DURHAM. By Messrs. JOHN DAGLISH, F.G.S., and G. B. FORSTER, M.A. (Report of the British Association for 1863, pp. 726–730.)

THIS paper was read at the Newcastle Meeting of the British Association, and was there so well received as to be among the few that were ordered to be printed in full in the volume of Transactions lately issued. The authors are well known mining-engineers of the northern coal-field, whose professional duties have given them repeated opportunities of investigating the structure of the Permian series of Durham; and these investigations have suggested to them conclusions at variance with the opinions of those geologists who have already examined and described these rocks.

The remarkable water-bearing properties† of these Permian rocks are first discussed; and their structure next engages the attention of the authors.

The 'Lower Red Sandstone.'—They point out that, while the series is considered by most geologists to include both the Magnesian Limestone and the so-called 'Lower Red Sandstone' beneath, and to be unconformable to the underlying Coal-measures; it is held by others to comprise only the Magnesian Limestone,—the sandstone being in that case classed with the Coal-measures. This, in fact, is a sort of border-land question,—a dispute about boundaries where land-marks are scarce, or perhaps never existed, and thus one not easy to settle.

The 'Lower Red Sandstone'‡ is composed of two portions:—

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* Bones of *Ursus maritimus*, Mr. Jukes states, have been found in Lough Gur.

† We shall return to this subject hereafter.

‡ This local term of 'Lower Red Sandstone,' or 'Lower New Red Sandstone,' formerly given in contradistinction to the 'Upper New Red Sandstone,' has sur-

an upper stratum which is yellow, incoherent, false-bedded, and of very irregular thickness; and, occasionally, a lower stratum, which is red, slightly micaceous, less false-bedded, containing the remains of Coal-plants, and, when present, appearing to pass upwards into the yellow sandstone. Either singly or combined, these sandstones are found to follow the range and dip of the limestone, and thus to rest on much lower beds of the Coal-measures in the south of Durham than they do in the north. Hence it is—on the doctrine of conformability—that the majority of geologists class this sandstone as Permian. On the other hand, all the fossils that have been discovered in it are referable to Carboniferous species; and for this reason it has been placed by other geologists with the Coal-measures.

Messrs. Daglish and Forster admit both the unconformability of this deposit, and its containing Coal-measure plants; but, so far as concerns the red sandstone, they are of the opinion, for several reasons, that it does not exist as an independent bed at all; but *is merely the reddened edges of the Coal-measure rocks themselves*; the discoloration, they explain, being due to the oxidation of the iron originally contained in the sandstone, by a lengthened exposure to atmospheric action. Considerable ingenuity is undoubtedly shown in this suggestion, though we cannot see how it meets the case in point. Colour is only one element in the character of rocks; and, before so novel a view could be accepted, the authors ought to show that the general structure of the Red Sandstone agrees with the notion of its being merely the red edges of successively outcropping Coal-measure strata. Moreover, atmospheric action—powerful though it undoubtedly is—is superficial. It acts on the surface, rather than on the interior of rock-masses; and we most certainly dispute that it would ever discolour a rock for a depth of fifty feet, let it have been exposed to its influence for what length of time it might; and fifty feet is not one-twentieth part of the thickness which equivalent red deposits attain in other regions.

For our part, we feel disposed to admit both the geological unconformability and the palæontological agreement of this 'Lower Red Sandstone' with the Coal-measures: but instead of attempting to dispute the existence of any part of the deposit, we think the facts of the case simply prove that the Carboniferous flora continued to exist after great physical disturbances in the British area;—and, perhaps, after all the strata we now call Carboniferous were deposited. Hitherto it has seemed most convenient to class this deposit as Permian; but there is much to be said in favour of each classification.

The Magnesian Limestone.—This deposit was first described by Professor Sedgwick, whose able memoir is still the text-book for its lithology. Professor W. King and Mr. R. Howse followed up the investigations of Sedgwick; and in 1850 the former, in the Introduc-

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vived the establishment of the latter as an independent and very distinct formation —the 'New Red Sandstone' proper.—Ed.

tion of his Monograph of Permian Fossils, proposed to arrange it and the sandstone beneath in six subdivisions, namely :—

Permian . . 1. Crystalline and Concretionary Limestone.
2. Brecciated and Pseudo-brecciated Limestone.
3. Fossiliferous Limestone.
4. Compact Limestone.
5. Marl-slate.
6. Lower Red Sandstone.

Professor King based this arrangement on both geological and palæontological evidence, and showed good reasons for its adoption. In 1857 Mr. Howse, adopting in principle the classification of King, suggested the following improved arrangement :—

Permian . . 1. Upper Limestone.
2. Middle Limestone (including Nos. 2 and 3 of King).
3. Lower Limestone.
4. Marl-slate.
Carboniferous. Lower Red Sandstone.

Since then the formation has been carefully examined by other geologists, British and Foreign, and their investigations have only helped to substantiate the views of King and Howse. In fact, it has been clearly shown that there is a regular sequence of beds to be observed in the Magnesian Limestone, and that it is not, as had been formerly supposed, one great calcareous deposit, with the same set of features throughout its whole mass. It has been shown that its upper portion is marked by characters which distinguish it not only from the rest of the deposit, but from every other rock in England; and that fully one half of the fossils occurring in it are peculiar, while the distribution of them all differs essentially from what obtains in the underlying beds. Also, that the middle portion differs in lithological aspect and in structure both from what is above and below it; while out of about 100 species of fossils which it contains, 35 do not occur elsewhere. Also, that the lowest beds possess, as a group, characters which are absent in the upper sections, and that as to fossils, though only five species are peculiar, the grouping shows considerable peculiarities. Lastly, that the Marl-slate at the base of the Magnesian Limestone differs in lithology, structure, and fossils from everything above it;—it being a laminated calcareo-argillaceous deposit, with a fauna of 15 species and a flora of 3; and out of these 11 forms are special.

We thus feel some surprise when we find that the authors do not adopt any such arrangement, but designate it as 'speculative' and regard it as 'extremely hazardous.' They state that, though certain well-marked lines of separation exist between different portions of the Magnesian Limestone, as Messrs. King and Howse have pointed out, there are yet other differences which these authors have not made use of. They moreover state that 'most probably all the variations of lithological structure, running through all the stages of friable, earthy, crystalline, botryoidal, &c., are simply due to the effects of local action at the time of deposition,—rocks of the same stratigraphical position taking alternately any or all of the above lithological types.' It is not unlikely that Messrs. Daglish and Forster, in arriving at these conclusions, have been too much influenced by their observations in pit-sections of the Magnesian Limestone. Indeed, they imply that from the information thus derived they have come to their present opinions; and they state that in pit-sections they have 'frequently had before them sections of the entire deposit.' This, however, is simply a mistake; for there is not a single pit in the Northern Coal-field that has ever passed through an entire section of the Magnesian Limestone. The majority of the pits penetrating the limestone are on the outcrop of its lower beds (*Lower Limestone*); some—Monkwearmouth, Ryhope, Seaton, Castle Eden, &c.—are on the outcrop of the middle member; but there are none which commence on any part of the Upper Limestone; and, as this member has been bored into, by the Sunderland and South Shields Water-company, at Cleadon, for a depth of 280 feet without reaching its base, and as we know it to be, by actual measurement, between 400 and 500 feet in thickness in another locality, it is evident that the pit-sections in Durham can give only an imperfect idea of the entire deposit. Taking pit-sections as their only guide in studying the structure of the Magnesian Limestone, the authors can never possibly comprehend the stratigraphical arrangement determined by King and Howse. Before they can place themselves in a position for judging whether that arrangement agrees with the facts of the case or not, they must see the whole of the formation to which it refers; and that they have not placed themselves in that position we feel perfectly satisfied, having too high an opinion of the authors' capacity of observation and correct judgment to suppose them capable of coming to the conclusions they have published had they all the facts before them. We are certain that had they gone into the field as practical geologists, and examined carefully the Magnesian Limestone as it is to be seen at the surface, as well as from the subterranean point of view which the duties of their profession have given them, they would have discovered that the generalization of Professor King was neither 'speculative' nor 'extremely hazardous,' but the legitimate conclusion of good observation. We say this because we know from personal examination that the lithological characters do not alternate in the way that the authors suggest. But even did they so vary, we question the propriety of deciding the subdivisional arrangement of any fossiliferous formation without considering its palæontological as well as its purely geological data. Of such importance, indeed, has palæontological evidence now become that it would be just as judicious for a modern mining engineer to lift his coal with a one-horse gin as for a geologist to attempt to classify sedimentary rocks without referring to their fossils. Nevertheless this is what the authors attempt to do; for they wholly ignore the palæontology of the Magnesian Limestone. For aught they say to the contrary, there might not be a single fossil in it; or fossils might be of no more consequence than so many *lusus naturæ*.

We have no desire to extend our criticism on the opinions which

Messrs. Daglish and Forster hold as to the stratigraphy of the Magnesian Limestone. Suffice it to repeat that we are fully persuaded that their opinions on that subject are not those which they would have held had their investigations been more carefully conducted in a geological point of view and more thoroughly carried out.

THE TRANSACTIONS OF THE DUDLEY AND MIDLAND GEOLOGICAL AND SCIENTIFIC SOCIETY AND FIELD-CLUB. No. 3, September, 1864, contains, among other communications, an agreeably written and sound paper by the Rev. H. Housman, on palæontology generally, on the increased value of fossils when studied not as merely isolated memorials of this or that long-past age, but as members of God's great creature-family, links in the great chain of life, and as holding definite places in the scale of being, either as ancestors, or as analogues, of the living creatures now flourishing on the earth. The *Lingulæ* and other Brachiopods, the Trilobite, *Pterygotus*, and other Crustaceans, are especially considered, as having existed from early times, and as illustrating the manner in which Life has spread over the world. Well-considered and concise remarks on the Literature of Geology are made in a short paper by the Rev. J. W. Bain, with truth and energy. In the Rev. W. Symonds's paper on the progress of Geological Science during the past year, he alludes to most of the later geological discoveries, and those tenets and theories which have some foundation in Philosophy. The *metamorphic* origin of many granitic and other rocks, once thought to have cooled from a molten state,—the presence of fossils in the Laurentian and Cambrian rocks, once thought to be *azoic*, and in Lower Silurian rocks once thought to be poor in organic remains and indefinite in position,—a better knowledge of the uppermost Silurian beds, of the 'Devonian' flora of NE. America, of the fishes of the Old Red Sandstone, of the 'Old Red' itself (especially of its probably two-fold aspect, and of its rightful possession of *Telerpeton* and *Stagonolepis*), of the Coal-measures and their fossil Reptiles, of the Permian plants and hæmatite, and of the Trias as occurring in New Zealand (New Caledonia and California may be added). Lastly, Mr. Symonds treats of the evidence of Man's existence in Western Europe since the Glacier-epoch, according to Prestwich and Lyell.

In his paper on the *Recent Discovery of Cannel-coal in North Wales*, Mr. Beckett, first briefly explaining the general bearings of the Flintshire and Denbighshire coal-fields, states that after having worked with Mr. E. Hull, of the Geological Survey, over this and the adjoining coal-area of Lancashire, he fully coincided with Mr. Hull in his opinion of the continuation of the coal-beds beneath the Mersey and the Dee, and also found some evidence of the existence in Flintshire of lower coal-beds than had been yet explored. Circumstances aided in necessitating deep sinkings (at Leeswood Green); and there, at about 93 yards below the 'Main-coal,' with seven or eight seams of coal intervening, a valuable Cannel-coal, nearly four feet thick, was reached. Other seams of good coal occur still lower down; and iron-ores and paraffine-shales accompany the series. At Leeswood Green, a fault fortunately brings the Cannel up to the level of the Main-coal. The Cannel is variable in quality, and to the South, in the Denbighshire Coal-field (separated by a great fault from the Flintshire area), the Cannel is represented by the 'Lower Yard Coal,' the good house-coal of Ruabon. Much interesting information is given in this paper, and it contains a well-merited compliment to the Geological Surveyors for their laborious and conscientious field-work, so little thought of or understood except by those who have to follow them, and adopt their useful results.

Mr. Jones, Secretary of the Society, read a paper (at the Cannock Chase Field-meeting), on Organization in Field-club work, well worth attention, particularly recommending *continuous* scientific work, in special directions, for the Botanists, Chemists, Geologists, and Antiquaries of particular districts, bringing their results to the natural centres, where the Clubs exist, and the preparation of Scientific Guide-books, as in the Malvern Club, or the recording of information as in the Institute of Mining Engineers for the Northern Coal-fields, and in the Dudley Society for South Staffordshire.

Mr. Rupert Kettle's paper on the working of the Ten-yard Coal, printed separately, is appended to this No. of the Transactions, but the discussions after the reading of the paper are fully given in the No. itself. A commission was appointed to undertake the necessary experiments and collect evidence. The paper is briefly noticed in the GEOLOGICAL MAGAZINE, No. 5.

THE DUBLIN QUARTERLY JOURNAL OF SCIENCE, CONTAINING PAPERS READ BEFORE THE ROYAL DUBLIN SOCIETY, THE ROYAL IRISH ACADEMY, THE GEOLOGICAL SOCIETY OF DUBLIN, AND THE NATURAL HISTORY SOCIETY OF DUBLIN. Edited by the Rev. S. HAUGHTON, M.D., F.R.S., Fellow of Trinity College, Dublin, and Professor of Geology in the University of Dublin. No. XVI. October, 1864.

IN this we find an enquiry (in Mr. H. O'Hara's paper), into the character and extent of the Irish coal-fields, peat-bogs, and supply of fuel, which ought, it seems, to be increased by plantations of timber-trees, by enlarged workings of the collieries, and by the adoption of improved methods in draining the peat-bogs, and in digging, drying, and compressing the peat. Detailed accounts of the Irish peat-bogs and coal-fields are to be found in this paper, together with a map of the former, and a map and sections of the latter.

REPORTS AND PROCEEDINGS.

GEOLOGICAL SOCIETY OF LONDON.

I. NOVEMBER 23, 1864.—The following communications were read:—1. 'On the Occurrence of Organic Remains in the Laurentian Rocks of Canada.' By Sir W. E. Logan, LL.D., F.R.S., F.G.S., Director of the Geological Survey of Canada.

Full notices of this and the next two papers have been given in the GEOLOGICAL MAGAZINE, vol. i. pp. 225–7 (No. 5, November 1865).

2. 'On the Structure of certain Organic Remains found in the Laurentian Rocks of Canada.' By J. W. Dawson, LL.D., F.R.S., F.G.S. With a Note by W. B. Carpenter, M D., F.R.S., F.G.S., who corroborated Dr. Dawson's observations on the structure and affinities of *Eozoön*, but stated also that, as he considered the characters furnished by the intimate structure of the shell to be of primary importance, and the plan of growth to have a subordinate value, he did not hesitate to express his belief in its affinities to *Nummulina*.

3. 'On the Mineralogy of certain Organic Remains found in the Laurentian Rocks of Canada.' By T. Sterry Hunt, Esq., M.A., F.R.S., of the Geological Survey of Canada. Communicated by Sir W. E. Logan, LL.D., F.R.S., F.G.S. (See above.)

II. December 7, 1864.—The following communications were read: —1. 'On the Geology of Otago, New Zealand.' By James Hector, M.D., F.G.S. In a letter to Sir R. I. Murchison, K.C.B., F.R.S. F.G.S. The south-western part of the Province of Otago is composed of crystalline rocks forming lofty and rugged mountains, and intersected by deeply cut valleys which are occupied by arms of the sea on the west, and by the great lakes on the east. These crystalline rocks comprise an ancient contorted gneiss, and a newer (probably not very old) series of hornblende-slate gneiss, quartzite, &c. Eastwards they are succeeded by well-bedded sandstones, shales, and porphyritic conglomerates, with greenstone-slates, &c., in patches, all probably of Lower Mesozoic age. Then follow the great auriferous schistose formations, which comprise an Upper, a Middle, and a Lower portion; and upon these occur a series of Tertiary deposits, the lowest of which may, however, possibly be of Upper Mesozoic date, while the upper, consisting of a Fresh-water and a Marine series, are unconformable to it, and are decidedly much more recent. (See also GEOLOGICAL MAGAZINE, No. 5, p. 233.)

In describing the auriferous formations, Dr. Hector stated that the quartz-veins occurring in the schists were not often true 'fissure-reefs' (that is, reefs that cut the strata nearly vertically and have a true back, or wall, independent of the foliation-planes), but are merely concretionary laminæ that conform to the planes of foliation: gold occurs segregated in the interspaces of this contorted schist, but is rarely found *in situ*.

Dr. Hector concluded with some remarks on the Tertiary volcanic rocks, observing that the period of their eruption must have been one of upheaval, and that the great depth of the valleys which have been excavated by glacier-action since the close of that period proves that the elevation of the island, at least in the mountain-region, must once have been enormously greater than it now is.

2. 'Note on communicating the Notes and Map of Dr. Julius Haast, illustrating the Glaciers and Rock-basins of New Zealand.' By Sir R. I. Murchison, K.C.B., F.R.S., F.G.S.—In this note Sir

Roderick Murchison stated that Dr. Haast has informed him in a letter that he has for the last five years attentively followed the discussions on Glacier-theories; that in March 1862 he came, independently of other authors, to the same conclusions in New Zealand that Prof. Ramsay did in Europe, and that his views have been printed in his Colonial Reports as Geologist of the Province of Canterbury. Sir Roderick also stated that the constant occupations of Dr. Haast, in the field and elsewhere, have hitherto prevented his carrying out his intention of writing a paper for the Geological Society; but he has sent the following notes as a *résumé* of his views. Though opposed to the theory of the excavation of basins in hard rocks by the action of ice, Sir Roderick commended the researches of Dr. Haast as showing the mutations of the surface in successive geological periods.

3. Notes on the Causes which have led to the Excavation of deep Lake-basins in hard Rocks in the Southern Alps of New Zealand.' By Julius Haast, Ph.D., F.G.S. Communicated by Sir R. Murchison, K.C.B., F.R.S., F.G.S.—Referring first to the submergence of New Zealand during the Pliocene period, and to its subsequent elevation, the author stated that the chief physical feature of the country after that elevation was a high mountain-range, from which glaciers of enormous volume, owing to peculiar meteorological conditions, descended into the plain below, removing in their course the loose Tertiary strata, and thus widening and enlarging the pre-existing depressions, the occurrence of which had at first determined the course of the glaciers. The author then observed that, the country having acquired a temporary stability, the glaciers became comparatively stationary, and therefore formed moraines, the materials of which were cemented together by the mud deposited from the water issuing from the glacier; new moraine-matter would then raise the bed of the outlet and dam up the water below the glacier: and from this moment, he believes, the formation and scooping out of the rock-basin begins; for, the ice being pressed downwards, and prevented by the moraine from descending, its force would be expended in excavating a basin in the rock below.

4. 'Note on a Sketch-Map of the Province of Canterbury, New Zealand, showing the Glaciation during the Pleistocene and Recent Times, as far as explored.' By Julius Haast, Ph.D., F.G.S. Communicated by Sir R. I. Murchison, K.C.B., F.R.S., F.G.S.—This paper contained a general explanation of a Sketch-Map illustrating the past and present distribution of the glaciers on the eastern side of the Southern Alps of New Zealand, as well as the author's views on the excavation of Lake-basins in hard rocks, as shown by the coincidence between the positions of the lakes and the terminations of the ancient glaciers.

ROYAL GEOLOGICAL SOCIETY OF IRELAND.—The first meeting for the session 1864–5 took place on the 9th November, in the New Buildings, Trinity College, Dublin. The chair was taken by R. Caldwell, Esq. The minutes of the last meeting having been read and confirmed, donations announced, and thanks voted, it was proposed and decided that, instead of in pounds, future subscriptions and compositions should be in guineas; and that Fellows should be elected in February (not more than 10), and, if need be, in June (not more than 5).

Mr. Scott stated that the Journal of the Society for the last session was ready, and would immediately be distributed to all Members whose subscriptions were paid up for 1864. It finished the series of ten volumes of the Journal of the Society under its former name; and the publication would be continued with a slightly varied title.

The Secretary read Mr. Foot's paper 'On a recent Erratic Block,' in which the author gave an account of a large block of limestone, weighing about two tons, which had been raised from its bed and carried for a distance of about fifty yards by the action of ice in the severe winter of 1855 at Rathclive, at the northern extremity of Lough Ree.

The Secretary also read a paper by Mr. John Kelly, containing his views on 'The Doctrine of Characteristic Fossils,' based on comparisons of those of the Silurian, Devonian, and Carboniferous Systems.

EDINBURGH GEOLOGICAL SOCIETY.—The annual meeting of the Edinburgh Geological Society was held on November 3rd, in their rooms at 5 St. Andrew's Square, Mr. David Page, F.G.S., F.R.S.E., the retiring president, in the chair. After the reports had been read, collections of minerals and fossils from Mr. James Anderson and Mr. Monteith were presented to the Society; and the following new office-bearers were elected for the ensuing session:—President, Mr. C. Maclaren, F.G.S.; vice-presidents, Mr. M. Lothian and Mr. D. Page, F.G.S., F.R.S.E.; secretary, Mr. G. C. Haswell; librarian, Mr. T. Smyth; treasurer, Mr. G. Lyon; curators, Messrs. T. R. Marshall and A. Somerville; council, Messrs. R. H. Bow, D. Marshall, J. R. S. Hunter, J. P. Falkner, S.S.C., James Haswell, M.A., and R. A. F. A. Coyne. Mr. Page, in his valedictory address, referred to the great discoveries which have been made in other countries during the past year, and to the questions which have been raised in consequence. The age of our rocks which we have been in the habit of calling metamorphic rocks, fundamental rocks, or the primordial zone, appears not to have been so very low in the geological formations as was supposed, or rather the geological scale must be extended downwards, so as to include, as fossiliferous rocks below those which in this country contain fossils, the Cambrian and Laurentian system. He then referred to the position of some questions which had been raised during the last session regarding the effect of metamorphism, the propriety of the term Old Red Sandstone as applied to the beds of Forfarshire, the age of the coal-beds of Borneo, New Zealand, aan Brazil, the age of the Greensand, the arrangement of the Post-tertiary system and the difficulties connected with the subject, and the Antiquity of Man. Mr. Maurice Lothian then took the chair, and a vote of thanks to Mr. Page for his conduct as chairman last session was heartily awarded by the meeting.

2. A fortnightly meeting of the Society was held November 24, Mr. C. Maclaren, president, in the chair. A communication on the *Dinornis robustus*, from Mr. T. Allis, vice-president of the Yorkshire Philosophical Society, sent in by Mr. J. Haswell, was the first paper read. Mr. David Page read a paper on the 'Wash-out' at Hailes Quarry. Premising that the terms 'Wash-out,' 'Nip-out,' and the like were employed by miners and quarry-men to designate certain deep troughs and gorges in the stratified rocks from which the solid matter of the strata had been eroded by aqueous or other action, Mr. Page drew attention to a very remarkable 'wash-out' at Hailes Quarry where the superincumbent shales and underlying sandstones had been cut through to the depth of sixty feet, and to a width varying from twelve or fourteen feet at the surface, but gradually narrowing to only two or three feet at the bottom. It was a wedge-shaped gorge, smoothed and polished on the sides by ice and watery action, and now filled with clay and boulders, the residue of the Glacial Period during which the 'wash-out' had been excavated. This gorge, and several others which he instanced, appeared to him to be evidences of the land-surface of the Glacial or Boulder Epoch, which had been eroded partly by running water and partly by moving ice, and, as the Glacial Period closed, had become filled with clay, boulders, and other débris, from the surface. The Hailes 'wash-out' was remarkable for its great depth and narrowness; but some, like one described at the Newcastle Meeting of the British Association in 1863, which could be traced for miles, and was upwards of 200 yards in width, were in fact the old river-courses of the country before, and perhaps during part of, the Glacial Era.

3. A meeting of this Society took place on December 1, Mr. M. Lothian, S.S.C., P.F., in the chair. Dr. Wrany, of the Pathological Library, Prague, was elected a foreign corresponding member. Mr. D. J. Brown read a paper on 'The Causes which lead to the Phenomenon of Mountains and Mountain-Chains.'

GEOLOGICAL SOCIETY OF GLASGOW.—The Monthly Meeting* was held in the library of the Andersonian University, on December 8th, E. A. Wünsch, Esq., in the chair. Mr. Armstrong exhibited six species of *Cypricardia* from the Carboniferous Shales of the West of Scotland, two of which were rare, and as yet undescribed. Two of them, *C. rhombea*, Phil., and *C. striato-lamellosa*, De Kon., from Craigen Glen, Campsie, he said, appear to be more characteristic of the lower stage of the Clydesdale Series, while the two undescribed species from Gare, Carluke, have as yet been found only in the Upper Marine Shales. Mr. A. Armour exhibited a collection of Ichthyolites from the Glasgow Coalfield, including some very fine and rare Ichthyodorulites, or Fish-spines, of the genera *Gyracan-*

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* The Monthly Lecture (Nov. 24) will be noticed in our next Number.

thus, *Ctenacanthus*, *Pleuracanthus*, and *Orthacanthus*—this last genus has not been hitherto recorded from this district. These large spines and some teeth and other Fish-remains were found in shale, forming the roof of the Splint-coal in the Cambuslang district, south-east of Glasgow. The chairman exhibited a series of specimens illustrating the fauna of the Old Red of Forfar, which he owed to the kindness of James Powrie, Esq., of Reswallie; also a photograph, by Mr. Powrie, of a group of these fossils. Mr. Crosskey also exhibited specimens of the Laurentian Gneiss of Sutherland, which is claimed by Sir R. Murchison as the oldest rock in the British Islands, and remarked upon their hornblendic character, and their dissimilarity to the gneiss of the Argyllshire district,—a view which was confirmed by Mr. Young. The secretary exhibited a variety of copper-ores, including the new and rare Cornish mineral *Langite*, from the collection of John Tennant, Esq., Garngad Hill, by whose kindness he had been enabled to exhibit it.

2. Mr. Young then drew attention to a number of very interesting local varieties of sandstones, from the Old Red and Carboniferous formations, and, with one or two exceptions, from the neighbourhood of the city. After describing the general character of our sandstone rocks, Mr. Young referred to some curiously blotched and circular-spotted sandstones from the Old Red near Dumbarton, which had long puzzled geologists and others as to how the peroxide of iron had been discharged from the stone; but as yet no satisfactory explanation had been given as to the real cause of the discoloration. A white sandstone from the same locality was full of black spots of bituminous matter, which stain the stones very much as if they had been sprinkled over with drops of coal-tar; and he said it was a very difficult question to decide whether these spots were due to the decay of organisms—no traces of which, however, can now be discovered in them, or have been produced by some other unknown natural cause. He next remarked on the specimens of black, brown, and striped sandstones from the Carboniferous formations, that owed their colour to bituminous matter, which had either been mixed with the sand by deposition along with it, or by sublimation from neighbouring coal-strata, penetrating the porous sandstone. Some of these contain a considerable quantity of volatile bituminous ingredients which can be readily distilled from the stone. In others, where the bituminous sandstone has been overlain by, or in contact with, igneous products, the bitumen had been converted into anthracite, and gives off no gas or flame; all of these sandstones become white by burning. One curious and unique variety of striped sandstone from Newton, near Cambuslang, excited much interest from the great regularity of its markings. Mr. Young stated that the base of this variety was brown, but at nearly regular intervals of fully one quarter of an inch, it alternates with thin, sharply defined, regular layers or stripes of white, of about half a line only in thickness, giving an almost artificial appearance to the stone. He did not consider this striping to be caused by the deposition of different coloured sands; for it is obliterated by burning; and the stone

then appears of a uniform sediment and colour, and without any distinct lamination. He was inclined to the opinion that during deposition, the sand had been laid bare at regular periodic intervals and exposed to the chemical action of light and heat, and while thus exposed, a thin layer of the upper surface was bleached, and changed from its normal brown colour, producing the thin line of white, by the abstraction of the volatile bituminous ingredients, and that this surface was covered up afterwards by fresh deposits of brown sand. No current, he said, could spread over the area of deposit so thin and persistent a layer of white sand as this bed represented, repeated at so many distinct and periodic intervals, such as the specimens before them indicated.

3. Mr. JOHN DOUGALL read a paper of some length, and of much interest, on 'The Ancient Sea-margins and Raised Beaches around Glasgow.' (To be noticed hereafter.)

4. Mr. J. W. YOUNG, in presenting the Analysis of an undescribed Red Mineral from the Gleniffer Braes, said, that he believed Mr. John Young was the first to direct the attention of the members to this mineral, which is found in amygdaloidal porphyry. It is by no means peculiar to that locality, and occurs frequently in different varieties of trap-rocks. He had made a rough analysis about eighteen months ago, and was struck with the large percentage (30 to 70) of iron-oxide which it contained. He had, however, now managed to make a full and careful analysis, and it gave him—water, 4·66; silica, 21·33; magnesia, 5·26; and peroxide of iron, 68·93. The specimen analysed was from porphyry of deep-red colour, and comparatively soft. If he might be allowed to propose a name for it, he would suggest 'Ferrite,' from the large percentage of iron it contains. Mr. John Young had obtained an analysis of a specimen from Langbank; it has nearly three *per cent.* less of iron-*oxide* in it, but appears to be harder than the other. The chief difference in their composition appears to be that the Paisley specimens contain no lime, but magnesia; while the other contains lime but no magnesia.

We have been favoured with the following note, and also with a specimen of the mineral, which may, we think, possibly prove to be pseudomorphous after felspar. —ED. G. M.

Remarks by Mr. John Young on the Mineral, from Gleniffer Braes, Paisley, analysed by Mr. J. W. Young, and proposed by him to be called 'Ferrite.'

This mineral occurs in several kinds of trap-rocks in the West of Scotland, in the deeper portions of which its crystals are of a blackish colour, often scarcely distinguishable from the dark base of the trap. Where the rock is porous, however, and the mineral has in consequence been affected by moisture or by the oxygen of the air, the crystals change to a bright deep red colour, which contrasts strongly with the dark colour of the stone. In this state they are softer, and the rock containing them becomes very friable. The crystals are regular in their form, and must have crystallized in the rock during the cooling of the mass. They do not occupy amygdaloidal cavities, as the zeolites. They cleave readily across, and show an oblong, six-sided section, which also breaks up into little cuboidal pieces. The size of the largest crystals is about six lines in length, by three in breadth. They are very abundant in some of the traps near Paisley and at Langbank on the Clyde, and have been found on the Campsie Fells and in Arran. The composition of the Ferrite from Langbank is as follows :—Water, 8·34 ; soluble silica, 2·56 ; insoluble silica, 18·33; carbonate of lime, 4·41 ; iron-oxide, 66·21 : total, 99 85. It is harder than the Paisley variety, the analysis of which is given above. The silica is there marked as 21·33 ; it might have been divided, however, thus :—Soluble silica, 11·80 ; insoluble silica, 9·53; total, 21·33.

NORWICH GEOLOGICAL SOCIETY, in connection with the Norfolk and Norwich Museum.—At a meeting, December 6th, Mr. J. O. Harper read a very instructive paper on the comparative anatomy of Rodents, illustrated with numerous specimens, among others several of the *Trogontherium Cuvieri* (a gigantic fossil Beaver found in the Forest-bed at Bacton, Norfolk), from the Museum and Mr. Gunn's collection. The discussion was adjourned to the next Meeting, when specimens of the Beaver (*Castor Europæus*) will be produced, it is hoped, for comparison, and with the view to clear up the doubts, which have been expressed by eminent Palæontologists who have visited the Norwich Museum, as to whether a small jaw in that collection is that of a young *Trogontherium*, or of the common Beaver. Mr. J. S. Offord undertook to have casts made of a femur and calcaneum of the *Trogontherium* for the Norwich Museum, and also for private distribution. Very fine specimens of a tooth of *Tapirus priscus*, and of three teeth and part of the jaw of *Hyracotherium leporinum*, from the Red Crag of Felixstow, were exhibited from the collection of Mr. Waters, of Manchester, and teeth of *Sus palæochœrus*, obtained from the Red Crag of Sutton, by Mr. J. H. Roper. of West Tofts, near Brandon, who has made a good collection from that deposit. For the identification of these teeth with specimens described by Professor Owen (Quart. Journ. Geol. Soc. vol. xii. p. 217 and Trans. Geol. Soc. 2nd Series, vol. vi. p. 203, pl. 21) the members are indebted to Mr. Henry Woodward, of the British Museum.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.—Nov. 29, 1864. Mr. R. D. Darbishire read a paper entitled 'Notes on Marine Shells found in Stratified Drift at Macclesfield,' and exhibited a series of specimens. The shells were collected from beds of sand and gravel exposed in the formation of the new Cemetery, at an elevation of 500 to 600 feet above the level of the sea. These beds are generally horizontal, but exhibit great irregularities of extension, level, and false-bedding. They rest on the 'Lower Boulder-clay.'

The whole of the 50 shells are ordinary British species, with the exception of four whose highest northern range is on our extreme south-west coast, namely *Cytherea chione*, *Cardium rusticum*, *Cardium aculeatum* (?), and *Arca lactea*.

Nine species, including *Cytherea chione*, have also been obtained from the patch of gravel discovered by Mr. Prestwich, at about 1,200 feet above the sea, on the east side of Macclesfield.

THE NATURAL HISTORY SOCIETY OF NORTHUMBERLAND, DURHAM, AND NEWCASTLE-ON-TYNE, held its first evening-meeting on Nov. 24, when a large and fashionable audience thronged the Museum of the Society in Westgate Street, Newcastle. A large number of the best microscopes and prepared objects were shown by members and their friends; and an address 'On Museums: their Uses and Management,' was delivered by Prof. Archer, director of the Industrial Museum of Scotland.

Under the new arrangement, the Natural History Society and the Tyneside Naturalists' Field-Club (which, preserving their independent existence, have entered into fraternal association), commenced their winter-evening meetings in the Walrus Room, on December 1st.

BRISTOL NATURALISTS' SOCIETY.—Geological Section, Oct. 28th.—Mr. W. Sanders, president, in the chair. Mr. J. Keal continued the discussion of the last meeting respecting the Lias beds of the neighbourhood, and gave an interesting account of his endeavours to discover the point of junction of the New Red Sandstone and the Lias, describing minutely the beds and fossils on Bedminster Down, the most noticeable of which were *Terebratula psilonoti*, at Colliker's Brook—an evidence of Lower Lias, and *Ammonites planorbis* at Yanley Lane. Mr. Keal went at great length into the question at issue between Mr. C. Moore, of Bath, and Dr. Wright, of Cheltenham; and concluded by proposing as a problem for solution, the range of the Saurians in the Bristol district, and their relation here to the *Ammonites planorbis*, which, he was satisfied, occurred above the White Lias. Mr. Sanders confirmed the last remark, and said that he did not consider the Saurians to be confined to any one zone; he pointed out the desirability of making a great number of accurate sections, to scale, of all the Lias beds, and correlating them, taking the Cotham or Landscape Marble as a good landmark from which to reckon vertical distances of beds, which should all be numbered, and notice taken of the fossils occurring in them. The Saltford section might be used as a model. Mr. W. W. Stoddart exhibited a large collection of fossil Entomostraca, or Water-fleas, which he had obtained from all formations—Silurian to Postpliocene. In the living state they were all aquatic, with two valves, and a chitinous skeleton, moulted yearly, which was the cause of the great abundance of their remains. With the exception of the well-known Trilobites, which he believed to belong to this class, they were all microscopic, and were obtained from the beds they occurred in, by disintegrating the stone with or without the use of hot and cold water, passing the powdered mass through sieves of various fineness, and picking out the minute fossils under a microscope.—*Bristol Daily Post*, Nov. 21, 1864.

NOTICES OF GEOLOGICAL PAPERS READ BEFORE THE BRITISH ASSOCIATION—*continued.*

NOTICE OF CARNASSIAL AND CANINE TEETH, FROM THE MENDIP CAVES, WHICH PROBABLY BELONG TO *FELIS ANTIQUA*. By W. A. SANFORD, Esq., F.G.S.

AMONG a quantity of bones from Hutton Cavern, in the Mendips, the author found a lower carnassial and an upper and a lower canine, of a large species of *Felis*, not *Felis spelæa*. These presented all the characteristics and measurements of *Felis pardus*, which is probably the same animal as that noticed and figured, though not described, by Cuvier under the name of *Felis antiqua*, though the figure differs in the size of the anterior lobe from that of the Mendip fossils. The measurements, however, exactly agree. He has therefore enumerated *Felis pardus* (syn. *F. antiqua*, Cuvier) as a British cave-fossil. He also called attention to the value of the comparative measurements of the length of the tooth from front to back, with that of the height of the base of the tooth from the crown to the bottom of the furrow, in the lower carnassial, as a means of discrimination between the different groups of *Felidæ*; and of the fact that the transverse measurement is so variable in the same species and even in the same individual, that it is valueless for the same purpose. It is by the former comparison, as also by the considerably larger size, that this tooth is distinguished from the corresponding tooth of *F. pardoides*, of Owen, from the Red Crag.

ON THE MAMMALIA OF THE NEWER PLIOCENE AGE IN THE CAVERNS AND RIVER-DEPOSITS OF SOMERSETSHIRE. By W. BOYD DAWKINS, B.A. (Oxon.), F.G.S., of the Geological Survey of Great Britain.

THE author, after giving a brief summary of the results of the exploration of upwards of eleven ossiferous caverns in the limestone of the Mendip Hills, by the Rev. J. Williams, Messrs. Beard and Stutchbury, Mr. Ayshford Sanford, F.G.S., and himself, described in outline the Mammalia that have been found in the county, and are preserved in the Museums of Taunton, Bath, and Bristol, and in Mr. Sanford's and his own cabinets.

The *Carnivora* are very largly represented. Of the *Felidæ*, the Cave-tiger (*Felis spelæa*), found alike in the caverns and gravels of the Avon, the Cave-panther (*Felis antiqua* of Cuvier), identified as a British fossil for the first time by his friend Mr. Sanford, and a small feline species allied to the Wild Cat, remind us of the association of animals obtaining *now* in the Altai Mountains. The Hyena (*Hyæna spelæa*, or Cave-hyena), found abundantly in two of the caves, presents those variations from the typical form of the lower true molar, which Messrs. Croizet and Jobert have ascribed to their *H. Perrieri*, and MM. De Serres, Dubreuil, and Jeanjean to their *H. intermedia*. The Bears are represented by two species at least—the Brown Bear of Europe, *Ursus arctos*, on the one hand, and the gigantic Cave-bear, *U. spelæus*, on the other. Between these two extremes of size are many varieties, which may perhaps turn out to be species, but they await an historian. The *Canidæ* are found in every cavern, and comprise the Fox and Wolf. The remains of

Badgers have been found at the Wookey Hole Hyena-den. The *Herbivora* are much more numerous in the caverns than the Carnivores. ***Elephas antiquus*** is associated with ***E. primigenius*** in Banwell and Bleadon Caverns, with ***Rhinoceros hemitœchus*** and ***Hippopotamus major*** on Durdham Down, and has been found also on the banks of the Exe. The Mammoth is common alike in the caves and the river-deposits. ***Rhinoceros tichorhinus*** and ***R. hemitœchus*** have been obtained from Wookey Hole. The remains of Horse are very generally met with: the caves of Bleadon and Durdham Down alone have yielded ***Hippopotamus major.*** The Wild Boar (*Sus scrofa*) has been obtained from both caves and river-gravels. The *Cervidæ* comprise the Irish Elk, Red-deer, Roe-deer, and Reindeer. The Bison (Aurochs, ***Bison priscus***), a second smaller variety or species (***B. minor***), and a third and yet smaller one, and the great *Urus* (*Bos* ***primigenius***), prove that the ***Bovidæ*** were abundant in the Newer Pliocene times in the district referred to. The ***Rodentia*** are represented by the Rabbit, Hare, and three species of Vole (***Arvicola agrestis, A. pratensis,*** and ***A. amphibia***). The discovery of the Marmot (***Spermophilus erythrogenoides,*** Falc.), we owe to the energy of Dr. Falconer.

But the last and most important addition to the fauna of the district in those early times is that of MAN. The implements of flint, chert, and bone found in the Wookey Hole Hyena-den, prove him to have been a contemporary of the Cave-bear, Cave-tiger, Mammoth, and two extinct species of Rhinoceros, and to have belonged as truly to the Cave-fauna as any of the extant Mammalia.

ON SOME NEW POINTS IN THE STRUCTURE OF PALÆCHINUS. By W. H. BAILY, Esq., F.L.S., F.G.S.

THE author stated that, having had occasion, for the purpose of comparison, to examine the fine series of fossils belonging to the genus *Palæchinus* in the well-known collection of Sir Richard Griffith, Bart., the eminent geologist, and Chief of the Valuation-department in Dublin, he was fortunate enough to find amongst these beautiful *Echini* of the Carboniferous Limestone one of the species *Palæchinus elegans,* from the lower beds of the limestone at Hook Point, Co. Wexford, which was sufficiently perfect to enable him to make out the arrangement of the plates composing the apical disk—an important part of the test or shell not hitherto described. He found that the principal plates were the same in number and position as in the Secondary and more recent forms of *Echini,* although differing in their proportions; there being five genital plates, one of which, rather larger than the rest, was probably the 'madreporiform plate,' and five ocular plates; these being much larger than usual in more recent forms, and the genital shorter in proportion to their breadth. In addition to these, there were inner circles of ten sur-anal and a similar number of anal plates.

The great peculiarity and most remarkable difference between this part of the *Palæchinus* and that of the recent *Echinidæ* was described as consisting of a double perforation of the ocular plates, and triple perforation of the genital plates.

Another addition to the structure of this interesting Palæozoic *Echinus*, made by Mr. Baily, was the discovery of spines which he had observed on a specimen of the same species, also from Hook Point, in the Collection of the Geological Survey of Ireland, a number of the minute spines still remaining attached to the plates, the principal tubercles on which are perforated, and surrounded by a circle of smaller ones. These spines were less than a tenth of an inch in length, and, on examination with a microscope, were found to be longitudinally striated.

On the Significance of the Sequence of Rocks and Fossils. By Harry Seeley, F.G.S.

HAVING assumed as axioms, that clays are the mud of rivers, that sandstones are the detritus of old crystalline rocks, while limestones were organically or chemically formed, the author contrasted the Cretaceous and Jurassic Rocks, and the sequence of the beds forming them; and, from the alternations of the strata, he deduced the alternations of the upheaval of continents and the nature of the rocks presented for denudation. He then, by way of illustration, worked out the physical geography of the Cretaceous period, as evidenced by the rocks of the Eastern and Northern Counties; and, having considered the effect of these physical revolutions upon the fauna of the ocean-floor, it was concluded that the operation of elevation and depression, in the ways pointed out, might produce all the phenomena of existing life-provinces on land and by sea, and similar life-provinces in the seas of past time. It was then shown that breaks between strata do not generally indicate denudation or breaks in time, but merely upheaval or depression of old lands, bringing into wear new rock-material, and causing the immigration of a new province of marine life. Mr. Seeley then showed that life was no measure of time; and concluded by controverting the teaching of Lyell, Forbes, Haughton, Hennessey, &c., that fossil species are any evidence of change of climate. He showed that one existing species could not tell anything about the climatal conditions of another, and therefore that the climate of extinct genera and families could not be inferred from existing analogues. The old faunæ were not universal; nor could the existing analogues have reached their present homes without wandering through very different climates. Evidence was adduced of extensive migrations, and it was concluded that in old times the *species* migrated, not the climate.

CORRESPONDENCE.

To the Editors of the Geological Magazine.

I think that it might be of service to those who, like myself, live in the neighbourhood of deposits containing the remains of Elephants and other large Mammalia, if you would describe the method that was used to extract the tusks of the Ilford specimen of *Elephas primigenius* from the matrix. I have seen many tusks ruined by unskilful

Mr. Bain's readiness to impart information on his favourite science, and the ardour he felt and inspired others with in its pursuit, will long be gratefully remembered by those who have been led by him to explore the fertile fields of South-African Geology.

Mr. Bain was a man of powerful frame and great physical energy and endurance; nor did he fail in a well-known attribute of a good geologist,—he was pre-eminently 'good company,' being gifted with great humour, and having a large fund of anecdotes of the early times of the Cape Settlement, rich in incident, which will give employment to the pen of some future Cooper. Moreover he had an excellent voice, and sang with great taste and feeling the songs of Burns and other bards of his native land. He was a warm friend; and brought up a family of ten children to be a credit to his name. Mr. Thomas Bain is employed in the same department as his late father was; and has already done good service in Geology.

The robust constitution of Mr. Bain showed, about two years ago, signs of having felt the strain to which his arduous labours had exposed it; and symptoms of heart-disease showed themselves. He came to this country last summer in the hope of recruiting his health; and had barely time to enjoy the warm reception of Sir R. I. Murchison, Professor Owen, and other leaders of science, to whom his labours had made him known, when the damp and cold of approaching winter rendered his return to the more genial climate of the Cape the only hope of prolonging his life. He died a few days after landing.—R. N. R.

THE COLOURING MATTER OF THE BLUE FOREST-MARBLE.—The chief colouring ingredient of rocks and of many minerals is iron in its several degrees of oxidation. Thus, we have red and brown jasper, &c., blue and red marls of the New Red Sandstone. Iron in another state of chemical combination has been recently determined by Prof. Church (Chem. Soc. Journ., Nov. 1864, p. 379) to give to the darker portion of the limestone of the Forest-Marble its blue colour. The bedded limestones of this formation are characterized, as is well known to geologists, by dark mesial bands in the blocks into which the rock has naturally divided. The dark band frequently constitutes nine-tenths of the bulk of a thick compact slab; very thin slabs are sometimes without a dark band. The dark stone is most abundant, and is of a deeper tint towards the base of the deposit. The lowermost stratum rests upon a blue clay of exactly the same tint as the dark stone, and owes its colour to the same substance. The colouring material of the dark bands is diffused iron-pyrites; the paler tint of the surrounding parts of the slab is due to the iron-oxide resulting from the oxidation of the pyrites. Similar appearances are familiar to us in the limestones of the Lower Lias, the deeper seated limestones being of a dark-blue colour, and those parts exposed to atmospheric agencies being light-grey or white; whilst intermediate portions exhibit the darker internal band as in the limestones of the Forest-Marble.—R. T.

THE
GEOLOGICAL MAGAZINE.

No. II.—FEBRUARY 1865.

ORIGINAL ARTICLES.

I. NOTES ON THE SHAPE AND STRUCTURE OF SOME PARTS OF THE ALPS, WITH REFERENCE TO DENUDATION.

By JOHN RUSKIN, Esq., F.G.S., &c.

IT is often said that controversies advance science. I believe, on the contrary, that they retard it—that they are wholly mischievous, and that all good scientific work is done in silence, till done completely. For party in politics, there are some conceivable, though no tenable, reasons; but scientific controversy in its origin must be always either an effort to obscure a discovery of which the fame is envied, or to claim credit for a discovery not yet distinctly established: and it seems to me there are but two courses for a man of sense respecting disputed statements;—if the matter of them be indeed doubtful, to work at it, and put questions about it, but not argue about it; so the thing will come out in its own time, or, if it stays in, will be no stumbling-block; but if the matter of them be not doubtful, to describe the facts which prove it, and leave them for what they are worth.

The subject of the existing glacial controversy between older and younger geologists seems to unite both characters. In some part, the facts are certain and need no discussion; in other points, uncertain, and incapable of being discussed. There are not yet data of measurement enough to enable us to calculate accurately the rate of diluvial or disintegrating action on mountains; there are not data of experiment enough to enable us to reason respecting the chemical and mechanical development of mountains; but all geologists know that every one of these forces must have been concerned in the formation of every rock in existence: so that a hostile separation into two parties, severally maintaining a theory of Erosion, and a theory of Fracture, seems like dividing on the question whether a cracked walnut owes its present state to nature or the nutcrackers. In some respects, the dispute is even more curious; the Erosion party taking, in Geology, nearly the position which they would occupy zoologically, if they asserted that bears owed the sharpness of their claws to their mothers' licking, and chickens the shortness of their feathers to the friction of the falling bit of shell they had run away with on their heads. For indeed the Alps, and all other great mountains, have been tenderly softened into shape; and Nature still, though perhaps with somewhat molluscous tongue, flinty with incalculable teeth, watches over her craggy little Bruins,

> '— forms, with plastic care,
> Each growing lump, and brings it to a bear.'

Very assuredly, also, the Alps first saw the world with a great deal of shell on their heads, of which little now remains; and that little by no means so cunningly held together as the fragments of the Portland Vase. No one will dispute that this shell has been deeply scratched, and clumsily patched; but the quite momentous part of the business is, that the creatures have been carefully Hatched! It is not the denudation of them, but the incubation, which is the main matter of interest concerning them. So that Professor Ramsay may surely be permitted to enjoy his glacial theory without molestation—as long as it will last. Sir Roderick Murchison's temperate and exhaustive statement * seems to me enough for its extinction; but where would be the harm of granting it, for peace' sake, even in its complete expansion? There were, we will suppose, rotatory glaciers—whirlpools of ecstatic ice—like whirling Dervishes, which excavated hollows in the Alps, as at the Baths of Leuk, or the plain of Sallenche, and passed afterwards out—'queue à queue'—through such narrow gates and ravines as those of Cluse. Gigantic glaciers in oscillation, like handsaws, severed the main ridge of the Alps, and hacked it away, for the most part, leaving only such heaps of sawdust as the chain of the Turin Superga; and here and there a fragment like the Viso and Cervin, to testify to the ancient height of the serrated ridge. Two vast longitudinal glaciers also split the spine of the Alps, east and west, like butcher's cleavers, each for sixty miles; then turned in accordance to the north ('Come si volge, con le piante strette, a terra, e intra se, donna che balli'),

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* Address at Anniversary Meeting of R. Geographical Society, 1864.

cut down through the lateral limestones, and plunged, with the whole weight of their precipitate ice, into what are now the pools of Geneva and Constance. The lakes of Maggiore, of Como, and Garda, are similar excavations by minor fury of ice-foam;—the Adriatic was excavated by the great glacier of Lombardy;—the Black Sea, by the ice of Caucasus before Prometheus stole fire;—the Baltic, by that of the Dovrefeldt, in the youth of Thor;—and Fleet Ditch in the days of the Dunciad by the snows of Snow Hill. Be it all so: but when all *is* so, there still was a Snow-hill for the snows to come down. —there still was a fixed arrangement of native eminence, which determined the direction and concentrated the energies of the rotatory, precipitate, or oscillatory ice. If this original arrangement be once investigated and thoroughly described, we may have some chance of ascertaining what has since happened to disturb it. But it is impossible to measure the disturbance before we understand the structure.

It is indeed true that the more we examine the Alps from sufficiently dominant elevations, the more the impression gains upon us of their being rather one continuously raised tract, divided into ridges by torrent and decay, than a chain of independent peaks: but this raised tract differs wholly in aspect from groups of hills which owe their essential form to diluvial action. The outlying clusters of Apennine between Siena and Rome are as symmetrically trenched by their torrents as if they were mere heaps of sand; and monotonously veined to their summits with ramifications of ravine; so that a large rhubarb-leaf, or thistle-leaf, cast in plaster, would give nearly a reduced model of any mass of them. But the circuit of the Alps, however sculptured by its rivers, is inherently fixed in a kind of organic form; its broad bar or islanded field of gneissitic rock, and the three vast wrinkled ridges of limestone which recoil northwards from it, like surges round a risen Kraken's back, are clearly defined in all their actions and resistances: the chasms worn in them by existing streams are in due proportion to the masses they divide; the denudations which in English hill-country so often efface the external evidence of faults or fissures, among the Alps either follow their tracks, or expose them in sections; and the Tertiary beds, which bear testimony to the greater energy of ancient diluvial action, form now a part of the elevated masses, and are affected by their metamorphism: so that at the turn of every glen new structural problems present themselves, and new conditions of chemical change. And over these I have now been meditating—or wondering—for some twenty years, expecting always that the advance of geology would interpret them for me: but time passes, and, while the aspect and anatomy of hills within five miles of Geneva remain yet unexplained, I find my brother-geologists disputing at the bottom of the lake. Will they pardon me if I at last take courage to ask them a few plain questions (respecting near and visible hills), for want of some answer to which I am sorely hindered in my endeavours to define the laws of mountain-form for purposes of art?

Fig. 1 is the front view, abstracted into the simplest terms, and laterally much shortened, of the northern portion of the ridge of the Mont Salève, five miles from Geneva.

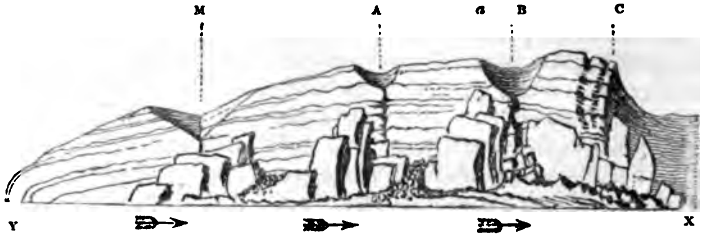

Fig. 1.—Northern portion of the Ridge of Mont Salève.

It is distinguished from the rest of the ridge by the boldness of its precipices, which terminate violently at the angle C, just above the little village called, probably from this very angle, 'Coin.' The rest of the ridge falls back behind this advanced corner, and is softer in contour, though ultimately, in its southern mass, greater in elevation. Fig. 2 is the section, under *a*, as I suppose it to be; and fig. 3, as it is given by Studer.

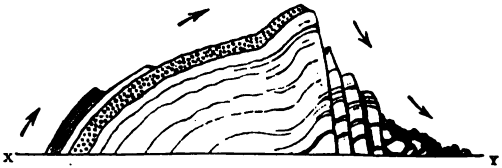

Fig. 2.—Section of Mont Salève at *a*, fig. 1. (Ruskin.)

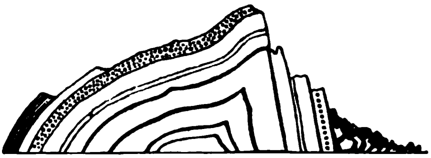

Fig. 3.—Section of Mont Salève at *a*, fig. 1. (Studer.)

To my immediate purpose, it is of no consequence which is the true section; but the determination of the question, ultimately, is of importance in relation to many of the foliated precipices of the Alps, in which it is difficult to distinguish whether their vertical cleavage across the beds is owing merely to disintegration and expansion, or to faults. In all cases of strata arched by elevation, the flank of the arch (if not all of it) must be elongated, or divided by fissures. The condition, in abstract geometrical terms, is shown in fig. 4. If A D was once a continuous bed, and the portion C D is raised to E F, any connecting portion, B C, will become of the form B E; and in doing this, either every particle of the rock must change its place, or fissures of some kind establish themselves. In the Alpine limestones, I think the operation is usually as at G H; but in the Salève the rock-structure is materially altered; so much so that I believe all appearance of fossils has been in portions obliterated. The Neocomian and the Coralline Jura of the body of the hill are highly fossiliferous; but I have scrambled among these vertical cleavages day after day in vain; and even Professor Favre renders no better account of them.*

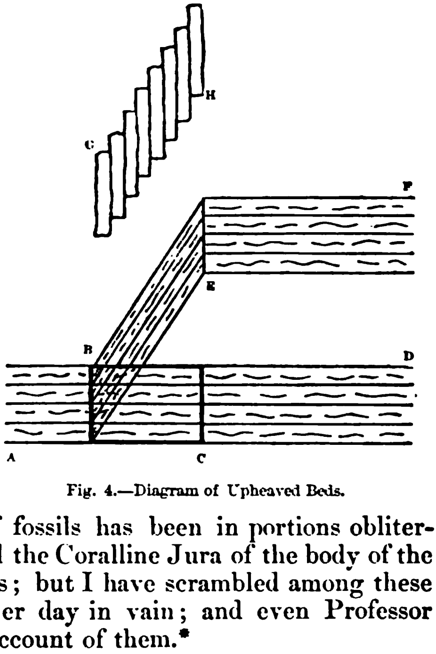

Fig. 4.—Diagram of Upheaved Beds.

The whole ridge of the mountain continues the curve of the eastern shore of the Lake of Geneva, and turns its rounded back to the chain of the Alps. The great Geneva glacier flowed by it, if ever, in the direction of the arrows from X to Y in fig. 1; and, if it cut it into its present shape, turned very sharply round the corner at C! The great Chamonix glacier flowed over it, if ever, in the direction of the arrows from X to Y in fig. 2. It probably never did, as there are no erratic blocks on the summits, though many are still left a little way down. But whatever these glaciers made of the mountain, or cut away from it, the existence of the ridge at all is originally owing to the elevation of its beds in a gentle arch longitudinally, and a steep semiarch transversely; and the valleys or hollows by which this ridge is now traversed, or trenched (M, the valley of Monnetier; A, the hollow called Petite Gorge; B, that called Grande Gorge; and C, the descent towards the Valley of Croisette), owe their origin to denudation, guided by curvilinear fissures, which affect and partly shape the summits of all the inner lateral limestone-ranges, as far as the Aiguille de Varens.

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* 'Considérations sur le Mont Salève,' Geneva, 1843, p. 12.

It is this guidance of the torrent-action by the fissures; the relation of the longitudinal fault to the great precipice; and the altered condition, not only of the beds on the cliff-side, but of the Molasse conglomerates on the eastern slope, to which I wish presently to direct attention: but I must give more drawings to explain the direction of these fissures than I have room for in this number of the Magazine; and also, before entering on the subject of the angular excavation of the valley at M, and curvilinear excavations at A and B, I want some answer to this question—one which has long embarrassed me:—The streams of the Alps are broadly divisible into three classes: 1st, those which fall over precipices in which they have cut no ravine whatever (as the Staubbach); 2nd, those which fall over precipices in which they have cut ravines a certain distance back (as the torrent descending from the Tournette to the Lake of Annecy); and, 3rd, those which have completed for themselves a sloping course through the entire mass of the beds they traverse (as the Eau Noire, and the stream of the Aletsch Glacier). The latter class—those which have completed their work—have often conquered the hardest rocks; the Eau Noire at Trient traverses as tough a gneiss as any in the Alps; while the Staubbach has not so much as cut back through the overhanging brow of its own cliff, though only of limestone! Are these three stages of work in anywise indicative of relative periods of time?—or do they mark different modes of the torrents' action on the rocks? I shall be very grateful for some definiteness of answer on this matter.

II. ON THE FOSSIL NECK-BONES OF A WHALE (*PALÆOCETUS SEDGWICKI*), FROM THE NEIGHBOURHOOD OF ELY.*

By HARRY SEELEY, F.G.S., Woodwardian Museum, Cambridge.

[Plate II.]

THOUGH the oldest English Whales yet named are found in the Crag, Prof. Sedgwick, a quarter of a century since, obtained from Ely some anchylosed cervical vertebræ evidently

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* This paper was read before the Phil. Soc. Cambridge, May 2, 1864.

Cetacean. The fossil was found at Roswell Pit in the Boulder-clay, but the Professor writes, 'I have not the shadow of a doubt that it was washed out of the Kimmeridge (or the Oxford) Clay, for both clays are near at hand. In condition it is exactly like the bones from those clays; and is utterly unlike the true Gravel bones, whether in the dry Gravel, or the Till.'* This is unmistakeable, for the specimen is mineralised with phosphate of lime; and so could have been derived from no deposit newer than the Crag. It is partly coated with stalagmite; but that condition was probably acquired while the fossil was embedded in the Drift; and when the thin crust is stripped off, the bone is quite like other bones from the Kimmeridge Clay. The Boulder-clay itself is largely made of nodules of Chalk and Kimmeridge Clay, with, if we may judge from fossils, a sprinkling from most of the older rocks; so, although an Upper Greensand fossil would have the same aspect, Prof. Sedgwick's determination of its age is legitimate, and probably true.

Professor Owen has examined the specimen, and in the 'Brit. Assoc. Reports' classed it as a species of *Delphinus*. In the 'British Fossil Mammals,' p. 520, it is spoken of as one of the *Delphinidæ*; and in the 'Palæontology,' p. 355, as an animal as large as a *Grampus*.

The fossil consists of the axis, third and fourth cervical vertebræ, and the neural arch of the fifth. The centra of the second and third are anchylosed. In outline they form a broad depressed triangle, 6¾ inches long by about 4 inches high; and from the odontoid process to the fourth vertebra they measure 3 inches: the odontoid process projects three-quarters of an inch; half the remaining thickness is made up of the axis, and the other half equally by the third and fourth vertebræ, with their interspace of an eighth of an inch. The third vertebra has a slight hypapophysis; the fourth is broken underneath: posteriorly, it shows the characteristic Cetacean unossified epiphysial surface.

In front the neural canal is a circular hole, 1⅝ inches across; but behind it is half an inch wider, the floor has become flat, and it is scarcely so high as in front, where it is made circular by sloping down to the odontoid process.

The articular surface of the axis is a little concave; it extends from the base as high as the middle of the neural canal, and is 5 inches wide, being nearly double the width of the fourth vertebra, which measures 2¾ inches wide, by 2¼ inches high. The odontoid process is in the middle of the centrum, concave above, convex below, and in a line with circular foramina at the sides of the articular surface. These are passages for the vertebral arteries; they measure but $\frac{3}{8}$ of an inch across in front, yet each expands behind like a funnel into an oval form, which is at the third vertebra 2 inches high, by $1\frac{1}{4}$ inches wide. In the axis it is but a perforation and excavation in a posterior bony expansion of the sides, but the arcs to the third and fourth vertebræ are slender bony rings : that of the fourth is most slender, and more contracted than in the other. They rise at the base of the neural arches, and terminate in the same plane as the bases of the centra, being there a little compressed laterally.

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* Letter in 'British Fossil Mammals,' p. 520.

The neural arches are very simple ; flattened above, they are concave at the sides, project slightly in front and behind, and are from $\frac{1}{2}$ to $\frac{3}{4}$ of an inch thick. There has been a slight neural spine to the axis, but it is rubbed away.

The sum of the features here described indicate, not a Cetacean of the Dolphin family, but a true Whale. The characters which more especially mark this are—the size and position of the passages for the vertebral arteries; the absence of neural spines, though in *Phocæna* they are no more developed; the relative depth of the vertebræ, and the position of the 'dentata.' There are some points of resemblance to Dolphins; but with *Balænoptera* the affinity is singularly close; and it is chiefly from the funnel-shaped artery-passages opening on the axis by a minute perforation that it is distinguished. Other distinctive characters are that in *Balænoptera* the 'dentata' is at the base of the spinal cord; that the vertebræ do not so rapidly decrease in size; that the processes are relatively larger; that only the neural arches of the second and third are anchylosed, and that the vertebral arcs do not form rings. None of these characters are very important, but the sum of them will justify a separation of the old Oolitic fossil from its living ally; and, as an old true Whale, I have named it *Palæocetus.**

EXPLANATION OF PLATE II.

Fig. 1. Front view of the 'axis' of *Palæocetus Sedgwicki*; half natural size.
2. Under view of 2nd, 3rd, and 4th cervical vertebræ of *P. Sedgwicki* ; half natural size.
(The figures are from Photographs by W. Farren, Cambridge.)

NOTE.—In Mr. Woodward's paper on *Plicatula sigillina*, GEOLOGICAL MAGAZINE, vol. i. p. 114, there is an error relating to this Whale. The fossil figured by Professor Owen in the 'British Fossil

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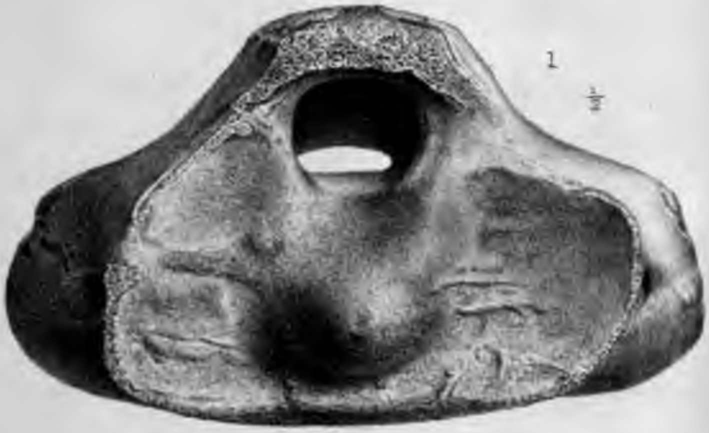
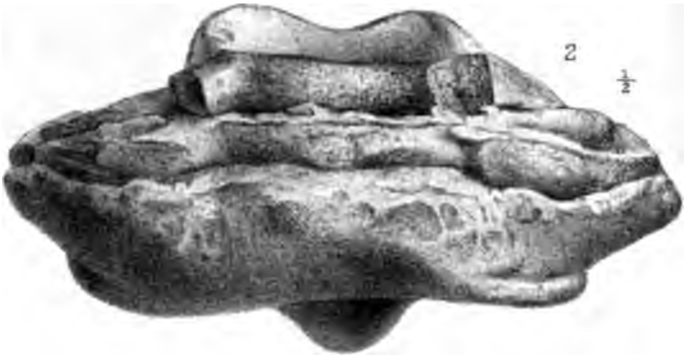
* While this was printing, I have been indebted to Dr. Gray for his memoir on British Cetacea; and am able to add that it also resembles *Physalus*, being nearest to *Ph. Sibbaldii* (Gray): in which the lateral processes of the axis resemble those of the fossil more closely than those in *Balænoptera* do ; but after the second, they do not form rings, in that species, while *Physalus* has all the vertebræ free. *Palæocctus* appears to connect these two genera.





G. West lith. M & N. Hanhart, Impᵗ

CERVICAL VERTEBRÆ OF PALÆOCETUS SEDGWICKII. Seel.

Mammals,' p. 520, is not the Woodwardian fossil here represented, but a true Delphinoid—*Phocæna crassidens.* Further, the evidence (in connection with *Plicatula sigillina*) on which our fossil was referred in Mr. Woodward's paper to the Upper Greensand is this;—the paint in the Woodwardian Museum is extremely bad; and, as the convex surfaces of the bone rested on it unmoved for years, it came off on the fossil, making little crescentic white patches which I at first mistook for worn remnants of the little fossil above mentioned.

I gladly annex the following letter:—

My dear Sir,—I thought the following observations on the Genus *Palæocetus* might be interesting to you, and you are quite welcome to make any use of them you like.

The Bones have great interest to me, as I think I have an Australian Whale that illustrates them.

They agree with *Balæna* in the cervical vertebræ being anchylosed. They differ from all the known *Balæna* in the Atlas, being free and separate from the other cervicals;—now in these characters they agree with a Genus of Whales which I have just described under the name *Macleayius*, from a specimen in the Australian Museum in Sydney.

The Genus *Palæocetus* differs, however, from *Balæna* and *Macleayius* in the form of the lateral processes of the cervical vertebræ. In *Balæna* and *Macleayius* the upper lateral processes of the second and following cervical vertebræ are small and rudimentary, and the lower lateral processes of the second and third cervical vertebræ are large, produced, enlarged and united at the end. They are all anchylosed together. But in *Palæocetus* the upper and lower lateral processes of the two vertebræ appear, by the Photographs you have sent me, to be short, united together, forming a rounded lobe in the middle of the side of the vertebræ, somewhat like (though much smaller and less developed) the ring-like lateral processes of the second cervical vertebræ of the true Finner-Whale (*Physalus*), showing that *Palæocetus* has many affinities, and decided characters for a genus. Indeed, I feel assured that it will form a Family, which may be called *Palæocetidæ*, perhaps the forerunner of a number of fossil species. Yours, very truly, John Edw. Gray.

British Museum: *Dec.* 20, 1864.

III. Note on *Xiphoteuthis elongata.*

By Professor John Phillips, F.R.S., &c.

THE very important addition to our knowledge of the *Belemnitidæ* contained in Professor Huxley's Memoir on *Xiphoteuthis* encourages the hope that, by following the steps of Mr. Day, we may clear up some other perplexities among the Cephalopoda of the Lias. One of the singular forms which presents itself for more complete inquiry is the fossil called by Mr. J. Sowerby *Belemnites pistilliformis*, found at Lyme-Regis. It is not the species so named by Blainville, which belongs to quite another part of the series of strata. The phragmocone is as yet undiscovered. If a considerable number of specimens be examined, including varieties of figure—club-shaped, fusiform, and subcylindrical,—there will appear enough of resemblance to the guard of *Xiphoteuthis* to suggest the probability that the phragmocone might be slender and elongate as in that fossil. The same idea has, indeed, already been expressed by Quenstedt ('Der Jura') in reference to *Bel. clavatus*, Blainv., a fossil rather common in the Lias, and which is probably identical with *Bel. pistilliformis* of Sowerby. Quenstedt expressly proposes to join *Orthoceratites elongatus* of De la Beche, which was unprovided with a guard, with *Bel. clavatus*, still deficient of a phragmocone. And, in addition to the English example of that phragmocone from Lyme, he figures ('Der Jura,' pl. 17, fig. 9) another, having similar general characters, from the Lias of Heckingen. It occurs to me to suggest that, by renewed search among the many existing collections of *Belemnites* from Lyme, some sure indications of the phragmocone of *Bel. clavatus* may yet be discovered, which may support or disprove the conjecture here hazarded of the affinity of this species to *Xiphoteuthis*. I sought in vain for such indication among the specimens of *Bel. clavatus* which I lately obtained from the upper parts of the Lower Lias of the Yorkshire Coast.

OXFORD: *Jan.* 12, 1865.

ABSTRACTS OF FOREIGN MEMOIRS.

THE RELATIONS OF THE MINERAL SPRINGS OF AX AND LUCHON, SOUTHERN FRANCE, TO METAMORPHIC ROCKS AND LINES OF FISSURE. By MM. L. MARTIN and F. GARRIGOU.*

THIS very brief but important memoir is intended to point out, by reference to the facts in a single instance, the relation that exists in nature between the direction of lines of Mineral Springs and the direction of systems of veins and recognized axes of elevation. 'The principle of parallel directions, applied with prudence in a region already geologically studied, may help to decide the age of the different disturbances which have determined the points of emergence, and therefore to class the Mineral Springs in natural geological groups, which, if this triple study be complete, would coincide with the grouping indicated by chemical analysis and medical observation.' These coincidences, therefore, are the tests of the theory.

The groups selected are the Thermal Springs of Ax and Luchon in the Pyrenees. The authors show—*first*, with regard to Ax, (A) that there are two classes of granitic rocks—1, fine-grained, with black mica, passing into gneiss, mica-schist, and aluminous schists; 2, coarse-grained, with large bluish crystals of orthose and silvery mica, with black tourmaline, garnets, pyrites, amphibole, &c., passing into pegmatite. It is with the latter granites, forming large veins bearing N. 27° W., that the Ax springs are in relation. The two granites pass one into the other.

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* Physique du Globe : Étude géologique sur les Eaux sulfureuses d'Ax (Ariége), et sur le groupe de sources auquel elles se rattachent : Note de MM. L. Martin et F. Garrigou, présentée par M. Daubrée. Comptes Rendus, Aug. 29, 1864.

(B) These veins are accompanied by a system of parallel fissures, extending through the stratified rocks to the Lower Chalk, thus fixing the age of the system of disturbances, which belongs to the elevation of Mont Viso.

(C) The metamorphic origin of these tourmaline-granites is well marked in various ways:—1, in the structure of the veins themselves; 2, because the granite-veins only traverse rocks containing all the material required for their composition; and, 3, because these veins, which are comparatively modern, are intersected by fissures and cracks much more ancient, which is easily understood if we admit that they have been modified and brought into their present state *in situ*.

Secondly, with regard to Luchon. The granites here are perfectly identical with those of Ax. The Mont Viso disturbances are repeated; and the springs are clearly seen to be in the direction of N. 27° W. It is not sufficient to say of them, that they rise at the contact of granites and enclosing stratified rocks. They occur in a system of parallel veins.

The Luchon and St. Béal district permit us to study the manner in which granites behave in cases where the rocks are alternately calcareous and siliceous. The granites avoid the limestone, arranging themselves in parallel planes between strata of limestone and gneiss.

It is probable that the system of N. 27° W. fissures originally permitted the issue of thermal springs containing sulphur and soda like those now issuing at Ax and Luchon; and that the metamorphic phenomena were thus produced on the rocks through which the waters passed. The action, necessarily elective, has chiefly affected the silicated rocks, the tourmaline-granites and pegmatites having been formed at the expense of the preceding rocks. The gneiss seems to have been the rock best adapted for transformation. Where limestone was absent, the large-grained granite takes the form of veins following the fissures. Where there was an alternation of limestone and siliceous rocks, the granite is arranged in bands alternating with the unchanged rocks.

The elevation of the Western Alps has produced in the same district a system of N. 24° E. fractures. These are of secondary importance at Ax and Luchon.

A relation of a purely geological kind exists between the system of springs at Ax and those of the Eastern Pyrenees. There is also a marked chemical distinction between the waters of Ax and Luchon in the alkaline reaction of sulphuret of sodium, which is remarkable at Ax, and absent at Luchon: and thus, in certain respects, Ax agrees with the Eastern Pyrenees.

Lastly, Ax is placed at the intersection of three important systems of disturbance, parallel to three axes of elevation, and generally it seems to be from intersections of systems that thermal springs rise to the surface. This principle may serve to assist in making out the true point from whence the system of thermo-mineral waters issues.

Leonhard und Geinitz's Neues Jahrbuch für Mineralogie, Geologie, und Palæontologie. Jahrgang 1864. Heft 6.

So much interesting matter is contained in this number of the 'Jahrbuch,' that our space will not allow us to devote more than a few words to the consideration of the subjects treated of in the several papers, of which there are seven.

In the first paper (Ueber die geologische Aufnahme Schwedens) Professor Erdmann gives a notice of the progress recently made, and of the results obtained, by the Geological Survey of Sweden. It is illustrated by lithographed sections, to which, however, no special reference is made in the text; a circumstance the more to be regretted as the sections appear sufficiently remarkable to merit careful description.

The next paper, 'On the Occurrence of Freshwater shells at the Irmelsberg, near Crock, in Thuringia' by Dr. Gümbel, with a Note by Dr. Geinitz, is sufficiently important and interesting to British geologists to call for special notice, and will be treated of separately.

Dr. Weiss, in his paper on Von Dechen's Geological Map of the Saarbrück Coal-formation, makes known the occurrence in the 'Lower Dyas'[*] of a new Crustacean, which the author refers to the genus *Estheria*, but which Dr. Geinitz describes, in a note, as belonging to the genus *Leaia*,[†] under the name of *Leaia Bäntschiana*, after the discoverer, Herr Bäntsch. The chief interest of this discovery lies in the fact that the three varieties of the only species of *Leaia* hitherto known—namely, *L. Leidyi*,[‡] Lea sp., *L. Leidyi*, var. *Williamsoniana*, Jones, and *L. Leidyi*, var. *Salteriana*, Jones, are of Carboniferous age. The new species is very similar to the varieties *Williamsoniana* and *Salteriana*.

Passing by Herr Deicke's paper 'On the Formation of the Molasse-rocks of Switzerland,' and that by Herr Bölsche 'On a new Discovery of Fossils in the Rauchwacke[§] of the Southern Margin of the Hartz,' we come to an important memoir by Herr Wolfgang Eras, 'On the Felsite-tuffs of Chemnitz' (Die Felsittuffe von Chemnitz), in which the author describes, and gives analyses of, the three principal varieties of the Felsite-tuff of the Zeisigwald near Chemnitz, as well as the compact Claystone of the 'Kreuzbruch' near Chemnitz. From his chemical investigations he deduces the probability of the origin of the Felsite-tuff being exclusively derived from the minerals felspar, quartz, and mica, as they contain all the chemical substances necessary to its formation; and he also shows that the composition of the compact Claystone is so similar to that of the Felsite-tuff, that the materials of both appear to be identical, although certain other facts, especially the columnar character of the former, show with equal clearness that plutonic forces contributed actively to its formation, in contradistinction to the purely sedimentary origin of the Felsite-tuff.

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[*] The 'Lower Dyas' (Geinitz), comprising the Rothliegendes ('Lower Red Sandstone' of the Durham geologists), may be regarded as the 'Lower Permian' of Murchison.—Ed.

[†] Dr. Dawson has lately met with a specimen of *Leaia* (and two or more of *Estheria*) in the Carboniferous rocks near Horton, Nova Scotia.—Ed.

[‡] Either of Lower Carboniferous or Upper Devonian age.

[§] A member of the 'Zechstein' or Magnesian Limestone.—Ed.

The last paper is 'On the Occurrence of Hatchettine at Wettin,' by Herr Wagner, and relates merely to the occurrence of that mineral, in masses which have hitherto been supposed to be Ozokerite, in the Royal Coal-mine at Wettin, in association with a notable quantity of rock-oil.—H. M. J.

REVIEWS.

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THE PHYSICAL GEOLOGY AND GEOGRAPHY OF GREAT BRITAIN. Six Lectures to Working Men, delivered in the Royal School of Mines in 1863. By A. C. RAMSAY, F.R.S., Local Director of the Geological Survey of Great Britain. Second Edition. 12mo. STANFORD, 1864.

PROFESSOR RAMSAY'S Lectures make a charming little book, written with all the freshness and simplicity of a novice taking up the pen for the first time, and contrasting as much with the stilted phraseology of the 'text-book' writers as the natural voice of a singer or preacher refreshes the ear wearied with *falsetto*. The Lecturer is under no such disciplined restraint as Professor Phillips imposes upon himself in the work lately noticed, but gives the reins to his fancy, and makes a succession of flights at all the great speculative questions of the day.

If the 'working men' expected no more than a dissertation on Practical Geology, they must have been agreeably surprised to find themselves flattered, instead, with an exposition of the most 'advanced' views of their lecturer. For, while exhibiting in a lively and intelligible manner the Geology of this country, of Wales, and of Scotland,—the topographical distribution of the strata and their various character, with their influence on the scenery, and on the occupations of the inhabitants,—he contrives to discuss the origin of rocks and rivers, the action of glaciers and atmospheric agencies in moulding the surface of the land, the excavation of lake-basins, the formation of mineral veins, and many other subjects of equal interest. 'Denudation' very properly forms a prominent topic; denudation in all its aspects—by rivers, by rain, by glaciers, by the sea. Every formation is but so much old material worked up again, with a small infusion of comparatively new matter—organic or volcanic—according to the spirit of the times.

The most famous of geological denudations—the Wealden area—has been commonly attributed to the action of the sea; and Mr. Darwin once calculated the exact time its excavation must have occupied, if eaten out by the waves at the rate of an inch in a century. Mr. Ramsay proposes to accomplish the same feat by 'atmospheric influences,' which would probably require as many ***hundreds of millions*** of years as the other fantasy. The denudation of the Weald may have been connected with the scooping out of the last portion of *La Manche* before the opening of the Straits of Dover; for there is evidence that the Chalk region of East Kent was continuous with that of Calais until after the immigration of the present Flora of the Downs; and it is pretty certain that the peculiar vegetation of the Hastings Sand-rock, with its Tonbridge and Azorean ferns, had been established at an earlier period. The localisation of plants and animals was accomplished by those very agencies of which we are accustomed to speak in terms as though they were cataclysmal; but it is more than probable that during all those changes of level and contour the country would have exhibited to a spectator of human capacity the aspect of supreme repose.

Mr. Ramsay tells us that the outlines and extent of all our coal-fields are determined by 'denudations,' and implies that they may all have once been *continuous.* This, however, is scarcely consistent with Mr. Prestwich's evidence of the thinning-out of the strata towards the margin of the Coalbrook 'Basin,' nor with the prevalence of ripple-marked sandstones, especially in Lancashire, proclaiming 'old sea-margins.' Whether the coal-measures were formed on low islands, or in swamps like the 'Great Dismal,' they must have been limited formations; and the existence of a coal-field in America as big as Great Britain does not raise a probability of many others having been as large.

The origin of Lake-basins is a pet subject with the Lecturer. He admits that his views have met with little favour hitherto, but expects they will ultimately be received. And received they may be to some extent,—but when it is proposed to explain the origin of nearly all the lake-basins in the world by the excavating power of Ice, in former times, a large demand is made on our capacity of belief. Our own Lakes, those of Westmoreland for example, have usually been supposed to occupy depressions caused by faults. We do not assert that this is the true explanation; but we regret that Mr. Ramsay, when citing many other speculations, never mentions this. The most important testimony in favour of the Ice-theory is that of Sir W. Logan, who states that the great American Lake-basins are depressions, not of geological structure, but of denudation. And he seems inclined to believe that glacial action has been one of the great causes which have produced those depressions. Mr. Ramsay's notions about Rivers and River-valleys will probably cause some astonishment to the disciples of Mr. Hopkins. Starting with the undeniable postulate that river-valleys are *not* *necessarily* connected with fracture, he goes on tacitly assuming that rivers always make their own channels. The style of demonstration is peculiar. Referring to the Vale of Reading, he asks: 'How did the Thames find its way through what was once that great unbroken scarped barrier of Chalk now called the Chiltern Hills?' The answer is grand: 'Such phenomena are not confined to this river alone—*it is a trick that rivers have.*'

The great River Niagara has, it is true, cut its way back unaided by any apparent fissure, like the miniature Chines of the Isle of Wight. But it has been demonstrated that the Wealden area could not have been raised to such an elevation as it has without producing fissures in the very situations now occupied by the river-channels; and, although these fissures may have borne no proportion to the wide, winding valleys that now intersect the downs, it is satisfactory to know that we have in them a directing cause.

The marvels effected by atmospheric agencies are not less remarkable than those of rivers and glaciers. The geologist may now remove any amount of limestone by means of sour peat-water—as Hannibal dissolved the Alps with vinegar. But we need go no farther than our own Chalk Downs to see the action of rain on a stratum of easy solubility. The 'swallow-holes' have been a fertile subject for contradictory speculation; and wherever the surface of the Chalk has been covered only by loam and gravel, it is furrowed and eroded. The fantastic outlines of the Chalk seen in some of the railway-banks near London could never have been exposed to the action of the sea, but have rather been formed, since the deposition of the brickearth over them, by the silent infiltration of rain-water dissolving the carbonate of lime and carrying it away laterally, and leaving the iron-stained siliceous residue.

When speaking of the use of decomposed granite in the manufacture of porcelain, Mr. Ramsay asserts that he has seen granite 'which had never been disturbed by the hand of man, that for a depth of twenty feet or more might be easily dug out with a shovel.' A fact like this speaks as emphatically for the long exposure of our Cornish moors as any evidence derived from the succession of organic life can prove the lapse of time while the Secondary rocks were forming. The aspect of high antiquity presented by the Scottish Mountains is explained by the statement of the Lecturer, that the carving-out of those peaks and ridges, cliffs and valleys, commenced before the time of 'that extremely venerable formation, the Old Red Sandstone.'

We are obliged to pass over Mr. Ramsay's views on the relations of the Stratified and the Igneous rocks, and the origin of Metamorphism. But we will mention that in an early page he gives the weight of his authority for the observation that there are vesicular lavas of Carboniferous age; thus dispelling the silly and improbable speculation that sub-aërial volcanoes had no existence until the Tertiary age.

In the lecture on *mining*, Mr. Ramsay gives a wholesome caution to those who are desirous of embarking in such speculations. The

Yankee scoundrel, who imposed on our credulous folks with his machine for finding gold where no gold existed, made good his retreat, but we trust his ill-gotten British gold has ere now faded into greenbacks.'

We are tempted to quote some passages respecting Coal; but the following will probably be less familiar:—'Late in the last century, there were still iron-furnaces in the Weald of Kent and Sussex. The last furnace is said to have been at Ashburnham; and every here and there you may now see heaps of slags, overgrown with grass, and the old dams which supplied the water that drove the water-wheels that worked the forges of Kent and Sussex. It is said that the cannon that were used in the fight with the Spanish Armada came from this district; and the rails round St. Paul's were also forged from the Wealden iron.'

We must give one parting word of commendation to the admirable little Geological Map which forms the frontispiece, and is a perfect *bijou* in its way. The woodcut sections of strata, small as they are, answer their purpose well.

The Geology of London and Neighbouring Country.

Memoirs of the Geological Survey of Great Britain and of the Museum of Practical Geology. The Geology of parts of Middlesex, Herts, Bucks, Berks, and Surrey. (Sheet 7 of the Map of the Geol. Survey of Great Britain.) By William Whitaker, B.A. (Lond.), F.G.S. Published by Order of the Lords Commissioners of Her Majesty's Treasury. 8vo. London: Longman & Co. 1864.

THIS Memoir, explanatory of 'Sheet 7' of the National Geological Map, is a good example of what a painstaking, conscientious, and well-read Geologist of the Survey can do,—of the admirable working of the national Institution that comprises the Geological Survey, Museum of Practical Geology, and School of Mines under an efficient and congenial Directorship,—and of the poor printing and paper with which, as usual, the Government delights to honour these valuable Memoirs. Although marked '7' on the cover, this monograph of local geology is the thirty-sixth of the useful, but badly printed, Memoirs* issued with the Sheets and Quarter-sheets of our great Geological Map, which, gradually spreading its illustrative colour-patches, complex but orderly, from Cornwall and Wales, over the Southern, Western, and Midland Counties, and among those of North Britain, has elucidated the underground structure, with its veins of metals, seams of coal, and sheets of well-waters, just as the workman's polish brings out the irregularly regular grain, and the well-ordered though mazy veinings, of wood and marble.

Within the limits of 'Sheet 7,' including the western part of London and the neighbourhoods of Uxbridge, Windsor, Wycombe, and Watford, the Memoir has to deal with—I. The Cretaceous Series, consisting of—1. Lower Greensand, obscurely recognized, however, by the boring of the Hampstead Well; 2. Gault (probably 200 feet thick); 3. Upper Greensand (about 70 feet thick under London); 4. Lower or flint-less Chalk (400 or 500 feet); 5. Chalk-rock (one or more peculiar, thin, hard, fossiliferous bands, that Mr. Whitaker has described in this Memoir and elsewhere); and, 6. Upper Chalk (about 300 feet): also local patches of 'Reconstructed Chalk,' and of 'Clay-with-flints.' The former must have been re-arranged before the laying down of the 'Reading Beds;' but the latter (noticed also under the same name* by M. E. Hébert as occurring in Picardy) Mr. Whitaker thinks may be of several different ages, having been, and perhaps now being, formed by dissolution of the Chalk by percolating waters.—II. Of the Eocene Series, we have—1. The Thanet Sand (found in London wells to vary from 13 to 44 feet), which soon thins out westward, but is thicker to the east. 2. The Woolwich and Reading Beds (from 25 to 90 feet), occupying along the strike, and in very numerous outliers,† a considerable area in 'Sheet 7.' 3 The London Clay (ranging from 380 to 440 feet in thickness near London, thicker to the E. and thinning to the W.) is, of course, an important feature in the geology of the London district; and with its revised and augmented lists of fossils,‡ (even

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* If we include the Map-sheets and Memoirs of the Irish Survey, there have been upwards of fifty published.

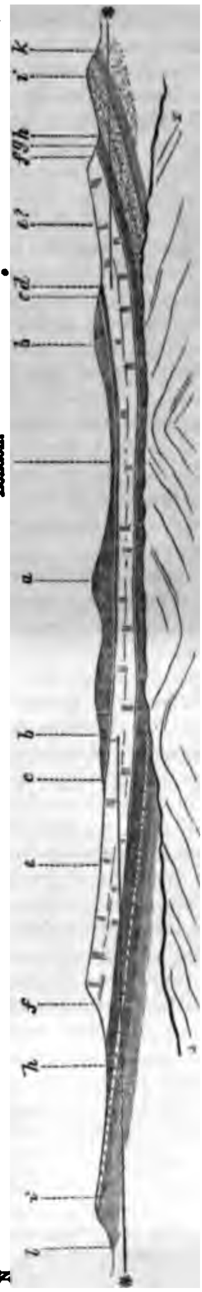

Diagram-section across the London Basin from North to South, showing the probable ridge of Old Rocks under London.

a. Lower Bagshot Sand.	*e.* Chalk with flints.	*i.* Lower Greensand.
b. London Clay.	*f.* Chalk without flints.	*k.* Wealden Beds (on the South).
c. Woolwich and Reading Beds.	*g.* Upper Greensand.	*l.* Oolitic Clays (on the North), with patches of Wealden, Purbeck, and Portland Beds.
d. Thanet Sand.	*h.* Gault.	*x x* Ridge of Older Rocks. *s s* Approximate Sea-level.

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* L'Argile à Silex; see GEOL. MAG. vol. i. p. 120.

† This is, of course, a word in frequent use in the Memoir; and so is the word 'Inlier,' as applied to a limited area of lower strata exposed by a local denudation of upper strata. Mr. Jukes (in his 'Manual,' 2nd edit.) uses this word differently, namely, for a particular bed intercalated among other beds. The former use of the word, however, not only seems very appropriate, but is older, having been introduced in a Geological Survey Memoir before 1861. It is the 'Outlier-by-protrusion' of Mr. Martin.

‡ For the vicinity of London only. The volume of the Palæontographical Society's Monographs, lately published, adds to their number.

its microscopic rhizopods, &c. are now tabulated,) it has a large chapter in this Memoir. 4. Of the Bagshot Series—the equivalent of the great Nummulitic Series of Europe, Asia, and North Africa—only the lower member (near Windsor and as outliers at Hampstead and Highgate) is shown in this Sheet; the great typical mass occurring in the neighbouring 'Sheet 8' (not yet described).—III. As old portions of the Post-Pliocene Series, and as 'Drifts of the Higher Levels,' Mr. Whitaker notices the Boulder-clay, his 'Clay-with-flints,' the High-level* Brickearth, and High-level Gravel, both the pebbly and the angular. Here also he notices the 'Grey-wethers' and 'Pudding-stones,' that lie about the surface. As later Post-Pliocene deposits, the Valley-gravel (with flint-implements) and its Brickearth, and the recent Alluvium, complete the list.

Throughout these descriptions the Author has carefully referred to, and fully quoted, Mr. Prestwich's researches on the Tertiary and Post-Tertiary deposits (indeed, the Geological Surveyors have accepted, with due acknowledgment, Mr. Prestwich's maps and sections as a basis for their own work in detail); and he evidently feels a pleasure in finishing the lines and filling in the tints of the masterly sketches of the 'London Tertiaries,' the 'Drift,' and the 'Flint-implement-bearing Gravels,' that Mr. Prestwich has set before Geologists.

The 'Form of the Ground,' some very suggestive remarks on the 'River-valleys,' and notes on 'Disturbances,' follow. There are also three Appendices;—two on Well-sections,† carefully tabulated; and one on the likelihood of there being an underground ridge of older rocks ‡ along the Valley of the Thames, as hinted at by De la Beche, well described (though unseen) by Godwin-Austen, and proved by Prestwich; and with this Mr. Whitaker gives the very instructive diagram here copied, which is itself equal to a chapter on the geological structure of the South-east of England, showing in detail what Mr. E. Hull's sketch-diagram (in his 'Coal-fields,' 2nd edit., p. 258) boldly indicates in a general manner.

Seventeen woodcuts, for the most part indifferently printed, illustrate the terraces of gravel near Maidenhead,—characteristic pit-sections (some, as Brockwell Hall Brickyard, not previously noticed),—and sections across the country, showing form of ground, dislocations, and other features, as at Windsor, Bushey, Lane End, Bennett's End, and elsewhere. A good Index of Places adds value to the work.

The Author throughout has evidently had a sharp eye for the Economics of Geology, such as Brickmaking, Pottery, Soils, Water-supply, &c.; but without that his pages are quite full enough of good sound Geology, based on well-observed facts and judicious reasoning.

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* Mr. Whitaker applies the words 'High-level Gravel' to that on the plateaux, and 'Low-level Gravel' to that of the valleys and so often left in terraces. This appears more correct than terming the highest of the Terrace-gravels 'High-level,' and leaving the Plateau-gravel higher still.

† That of Colney Hatch appears to have been left out by mischance. Mr. Whitaker expresses a wish to be informed of any new sections and well-diggings.

‡ We have seen the specimen of Lower Carboniferous *Posidonomya* that was brought up by the borer from these old rocks at Harwich, mentioned at p. 252 of the Geol. Soc. Journal, vol. xiv.

THE STRUCTURE OF BELEMNITES, WITH AN ACCOUNT OF A NEW GENUS (*Xiphoteuthis.*) By Professor HUXLEY, F.R.S., &c.

MEMOIRS OF THE GEOLOGICAL SURVEY OF THE UNITED KINGDOM. FIGURES AND DESCRIPTIONS ILLUSTRATIVE OF BRITISH ORGANIC REMAINS, Monograph II. 8vo. Accompanied by three folio Plates. 1864. London: LONGMAN & Co.

THIS Memoir conveys the results of the Author's careful observations on the structure of the Belemnitidæ as shown by more complete specimens of *Belemnites*[*] than previously described, and comprises an account of his new genus *Xiphoteuthis*, founded on some nearly perfect specimens lately discovered by Mr. Day in the Lias of Charmouth.

Of all the extinct forms of animal life, few perhaps have received more attention than the Belemnite and its allies,—a group characterising the Secondary strata. Without entering into the intricate book-history of these curious fossils, noticed even by P. Belon and G. Agricola (1553–58) under the name of 'Belemnites,' Mr. Huxley has selected the more recent and important observations bearing upon the structure of the Belemnite, and its relationship to existing Cephalopods,—namely, those by Buckland (1829, 1836), Voltz (1830, 1836, 1840), Münster (1830), Agassiz (1835), Quenstedt (1839, 1849, 1852), Duval Jouve (1841), D'Orbigny (1842), Pearce and Cunnington (1842), Owen (1844), Mantell (1848), Woodward (1851, 1856), and Pictet (1854).

The Belemnite, as usually found, consists simply of the well-known subcylindrical calcareous fossil so called (the 'Thunderbolt,' 'St. Peter's Fingers,' &c. of peasants). This is the 'guard' or 'rostrum,' with a conical cavity ('alveolus') at its broader end, containing a conical series of numerous chambers ('loculi,' Huxley), enclosed in a thin shell-wall ('conotheca,' Huxley), and traversed vertically ono ne side (middle of the ventral) by the 'siphuncle.' This chambered portion is the 'phragmacone' (Owen). Continuous with the upper part of the 'conotheca,' is sometimes found a thin shelly substance ('pro-ostracum,' Huxley), which has been the subject of much discussion, as to its presumed identity with the 'pen' or 'osselet' of the recent Cuttlefish. 'According to Dr. Buckland, this part is a corneous, or shelly, and more or less completely nacreous extension forward of the lip of the "phragmacone." According to Agassiz, it is a "pen" identical with that of the so-called *Loligo Bollensis*, &c. According to Voltz, it is a "pen" analogous to that of *Loligo Bollensis*. According to Mantell and Quenstedt, it is a broad dorsal plate, more or less corneous in the middle, and with two strong calcified "asymptotic bands."' Prof. Huxley is now enabled to prove that this important part in the *Belemnitidæ* corresponds with a portion only of the 'pen' of the Cuttlefish; and for that reason he gives it the special name of 'pro-ostracum:' he also points out that, in specimens he has examined, this part presents three distinct types of form:—1st (as in *Belemnites elongatus*), 'prolonged as a broad spatulate plate along the whole length of the dorsal region of the mantle, and produced laterally and inferiorly, for an unknown distance, along the lateral and ventral regions of the body:' 2nd (as in *B. attenuatus*, which is probably the same as *B. Owenii* and *B. Puzosianus*), it is 'very thin, apparently horny, or imperfectly calcified, in the dorsal region, and supported laterally by two thin calcareous bands, or pillars, which, inferiorly, expand upon the "conotheca:"' 3rd (as in *Xiphoteuthis elongata*), very long and narrow, partly flat, partly subcylindrical: and, 4thly (as in a *Belemnoteuthis* in the British Museum), a different, but not yet determinable, form.*

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[*] In the Collections of the Rev. J. Montefiore, Mr. Henry Norris, sen., and Mr. Day, and in the British Museum.

The 'conotheca' on its outside bears certain curved lines, which are of importance in the study of *Belemnites*, in consequence of their being regarded as indicative of the probable form of the edge (often missing) of the 'pro-ostracum.' These 'conothecal striæ' differ very considerably in specimens hitherto observed by Voltz, Quenstedt, D'Orbigny, and others. Prof. Huxley remarks on this point:—

> 'If the arrangement of the conothecal lines indicates the form of the "pro-ostracum," and *vice versâ*, the majority of *Belemnites* ought to have a two-banded "pro-ostracum" like that of *B. Puzosianus*; and, on the other hand, the peculiar arrangement of the "conothecal" lines of the present "phragmacone" [from the Ammonites-obtusus zone of the Lias, and in the Rev. J. Montefiore's Collection] ought to indicate that it was associated with a different kind of pro-ostracum; and, so far, there may be ground for suspecting that it belonged to some of the species which have "pro-ostraca" like that of *B. Bruguierianus*. But I am by no means satisfied of the justice of Voltz's assumption, which D'Orbigny and others adopt,—that the "conothecal lines" must indicate the form of the "pro-ostracum;" since the latter may readily have been modified by the deposition of shelly matter upon its exterior, after its first formation.'

Prof. Huxley demonstrates that certain true *Belemnites* were provided with hooks on the arms, horny beaks, and a large ink-bag. These features, as well as the 'pro-ostracum,' 'conothecal striæ,' and

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* As it seems to have escaped notice, and is certainly of interest, we may remark that Buffon in 1774 recognized in some well-preserved Belemnites, which he very clearly describes, dug up from Oolitic clay at Montbard, *a sort of appendix, continuous with the coating of the little chambered cone of the Belemnite, of a yellowish colour, calcareous in substance like the shell, extremely tender, and having the form of a wide flattened funnel, nearly two inches long, and tapering from one inch at the widest to six lines at its junction with the Belemnite.* Although Buffon could not decide what Belemnites really were, yet he distinctly called the attention of Naturalists to the fact that they had not hitherto recognized all the parts of these curious shells; and he suggested that this additional evidence of their structure might assist in determining the class to which they really belong. (See 'Explication de la Carte Géol. de France,' vol. ii. p. 347, &c.)

peculiar cuticle of the 'guard' (in *B elongatus*), are extremely well shown in Liassic specimens (from the collections above mentioned) beautifully figured in the plates of this Monograph. The Author states, that, with an ink-bag 1·4 inch long and ·55 inch broad, the shell of *B. elongatus* would be (from apex to mouth of 'phragmacone') 5·35 inches long, the 'guard' being 2¼ inches long from its apex to its expansion at the base of the 'phragmacone,' and ·25 inch broad; and he suggests that 'these measurements may enable one to form a rough estimate of the size of 'guard' which appertained to any detached ink-bag, and *vice versâ*. We may also suggest, that, finding an ink-bag in the clay, the collector may hence be led to make careful examination throughout a calculated distance, in a line with it, for other parts of the animal. According to the figured specimen of the above measurements, the arms and hooks would be about two inches in advance of the ink-bag.

Naturalists, having now a perfect Belemnite before them, can affirm, with Buckland and Woodward, the existence of the ink-bag as a matter of direct observation. The ink-bearing 'Belemnosepia' of Agassiz and Buckland is therefore a *Belemnites*, and does not belong to the *Teuthidæ* or Squids. Mr. Huxley dwells also on the relationship of *Belemnites* and *Belemnoteuthis*, the latter of which, he thinks, will prove to have a 'pro-ostracum' of peculiar form. *Acanthoteuthis*, founded on incomplete remains in the Solenhofen Oolite, may belong either to the better known *Belemnites*, *Belemnoteuthis*, or *Plesioteuthis*, or even to *Kelæno*.

The new Cephalopodous Genus described in Professor Huxley's Monograph has been hitherto imperfectly known by a fragmentary specimen in the Geological Society's Museum, and figured and described by De la Beche in 1829 as *Orthocera elongata* (Geol. Transact., 2nd ser., vol. ii. p. 28, pl. 4, fig. 4); but its real nature was first revealed by some fine specimens found by Mr. Day in the lower part (Belemnite-beds) of the Middle Lias near Lyme-Regis. It consists of a narrow, cylindrical, structureless 'guard,' about 3 inches long, about ⅕th inch thick, and containing a long tapering 'phragmocone,' the chambers of which much resemble those of an *Orthoceras*. The 'conotheca' passes upwards into a remarkable 'pro-ostracum,' nearly 12 inches long; at its base it is a flat band only ·35 inch broad, narrowing to about ·2 inch; in its upper half, widening and becoming convex, it is ·5 inch broad, and then tapers to a point. It has a polished surface, wrinkled transversely just below its widest part. It is composed of concentric lamellæ, with fibres perpendicular to their planes, as in the 'guard' of an ordinary Belemnite. No ink-bag, hooks, nor beaks have yet been found associated with this internal shell, which is generically distinguished from other *Belemnitidæ* by the form and structure of its 'pro-ostracum,' its long, narrow, deep-chambered 'phragmocone,' and its cylindrical 'guard.'

'The genera hitherto enumerated,' says Mr. Huxley, 'in the family of the *Belemnitæ*, characterized among the Dibranchiate *Cephalopoda* by possessing a straight, chambered, siphunculated, internal shell, or "phragmacone," are *Belemnites, Belemnitella, Belemnoteuthis, Beloptera,* and *Conoteuthis.* To these *Xiphoteuthis* must now be added; and I think it very probable that by-and-by it will be found necessary to subdivide *Belemnites*, the difference between the "pro-ostraca" of *B. Bruguierianus* and *B. Puzosianus* being, probably, of generic importance. The extent of our knowledge of the structure of these different genera is very unequal. Of *Belemnoteuthis*, the body and arms, hooks, ink-bag, and internal shell are all known, few fossilized animals having left more complete remains; of *Belemnites*, the specimens described in this paper have made known, for the first time, the form and proportions of the body and the arms, the hooks, the ink-bag, one type of "pro-ostracum," and less perfectly the beak; of *Xiphoteuthis*, the almost complete internal shell is known; of *Conoteuthis*, the "phragmacone" and part of the "pro-ostracum;" of *Beloptera* and *Belemnitella*, only the "phragmacone" and "guard;" but with the hooks, ink-bag, or soft parts of these last four genera we have no acquaintance.'

REPORTS AND PROCEEDINGS.

GEOLOGICAL SOCIETY OF LONDON.—I. Dec. 21, 1864. The following communications were read:—

1. 'On the Coal-measures of New South Wales, with *Spirifer*, *Glossopteris*, and *Lepidodendron*.' By W. Keene, Esq. Communicated by the Assistant-Secretary.

This important paper, showing the occurrence of *Vertebraria* and *Glossopteris* throughout the Coal-measures,—of *Spirifer*, *Orthoceras*, *Bellerophon*, &c. in some of the beds,—and of *Lepidodendron* in the lowest grit of the series, has already been noticed, among the British Assoc. Reports, in the GEOLOGICAL MAGAZINE, Vol. I. p. 233.

2. 'On the Drift of the East of England and its Divisions.' By S. V. Wood, jun., Esq., F.G.S.

In this paper the author divides the Drift of the country extending from Flamborough Head to the Thames, and from the Sea on the east to Bedford and Watford on the west, as follows:—*a*, the Upper Drift, having a thickness of at least 160 feet still remaining in places; *b* and *c*, the Lower Drift, consisting of an Upper series (*b*), having a thickness from 10 to 70 feet, and a Lower series (*c*), with a thickness, on the coast near Cromer, of from 200 to 250 feet, but rapidly attenuating inland. *c* comprises the Boulder-till, and overlying Contorted Drift on the Cromer coast, which along that line crop out from below *b* a few miles inland. *c* also, in an attenuated form, ranges inland as far south as Thetford, and probably to the centre of Suffolk, cropping out from below *b* by Dalling, Walsingham, and Weasenham, and appearing at the bottom of the valleys of central Norfolk. *b* consists of sands, which on the east coast overlie the Fluvio-marine and Red Crag, but change west and south into gravels, which pass under *a* and crop out again on the north, south, and centre of Norfolk, and west of Suffolk and Essex, extending (but capped in many places by *a*) over most of Herts. The Upper Drift (*a*) consists of the wide-spread Boulder-clay, which overlaps *b*, for a small space, on the south-east in Essex, and again at Horseheath, near Saffron-Walden, but overlaps it altogether on the north-west, resting on the Secondary rocks in Huntingdonshire and Lincolnshire. The distribution of *b* indicates it as the deposit of an irregular bay, afterwards submerged by the sea of *a*, which overspread a very wide area. *a* now remains only in detached tracts, having been extensively denuded on its emergence at the beginning of the Post-glacial Age, so that wide intervals of denudation (separating the tracts) indicate the Post-glacial straits and seas which washed islands formed of *a*. The author considers the so-called Norwich Crag of the Cromer coast as *not* of the age of the Fluvio-marine Crag of Norwich, but as an arctic bed forming the base of *c*, into which it passes up uninterruptedly. The author regards the beds *b* as identical with the fluvio-marine gravels of Kelsea, near Hull; and the Kelsea bed not to be above *a*, as hitherto supposed, but below it, having been forced up through *a* into its present position. He also regards the Upper Drift (*a*) as the equivalent of the Belgian Loess, and the beds *b* as the equivalent of the Belgian *Sables de Campine.*

II. Jan. 11, 1865. The following communications were read:—

1. 'On the Lias Outliers at Knowle and Wootton Wawen in South Warwickshire.' By the Rev. P. B. Brodie, M.A., F.G.S.—[See GEOLOGICAL MAGAZINE, Vol. I. p. 239.]

2. 'On the History of the last Geological Changes in Scotland.' By T. F. Jamieson, Esq., F.G.S.

The history of the last geological changes in Scotland, as given in this paper, was divided into three periods, namely, the Preglacial, the Glacial, and the Post-glacial.

The absence of the later Tertiary strata from Scotland leaves the history of the Preglacial period very obscure; but the author considered it in some degree represented by some thick masses of sand and gravel (apparently equivalent to the Red Crag of England) on the coast of Aberdeenshire; and he stated that there were indications of the Mammoth having inhabited Scotland during this period.

The Glacial period was divided into three successive portions, namely, (1) the Period of Land-ice, during which the rocky surface was worn, scratched, and striated, and the boulder-earth, or glacier-mud, was formed; (2) the Period of Depression, in which the glacial marine beds were formed; and (3) the Period of the Emergence of the land to which belong the valley-gravels and moraines, and during which the final retreat of the glaciers took place.

To the Post-glacial period Mr. Jamieson referred that of the formation of the submarine forest-beds, which he considered was succeeded by a Second Period of Depression, and this again by the elevation of the land to its present position. It is in the old estuary beds and beaches formed during the Second Period of Depression that the author finds the first traces of Man in Scotland, while the Shell-mounds with chipped flints he referred to the same epoch as the blown sand and beds of peat, namely, to the most recent period, during which the land was raised to its present level.

Mr. Jamieson described in great detail the deposits representing each of these periods, and concluded his paper with lists of shells from the different beds, showing the percentage of the species that are now found in the British, Southern, Arctic, North-east American, and North Pacific regions.

GEOLOGISTS' ASSOCIATION, Tuesday evening, Dec. 6, 1864; E. Cresy, Esq., President, in the chair.—Mr. TOMLINSON, of King's College, read a paper entitled 'Two Days on the Chesil Bank,' in which he described a visit to that remarkable bank of shingle, the most extensive in Europe, extending, as it does, from Burton Cliff, near Bridport, to the Isle of Portland, a distance of nearly nineteen miles. Mr. Tomlinson did what few visitors to this part of our coast care to do: he walked the whole length of the Bank, which in the last ten miles has no other path than the loose shingle. He also collected (and exhibited) pebbles from different parts of the Bank, not only to illustrate their species, but also the remarkable and gradual increase in size, from blown sand at Burton Cliff, to pebbles of the size of turnips at the village of Chesil. Among the pebbles, those of rolled flint or of translucent quartz are most abundant: there were also pebbles of black Fuller's earth, black Devonian Limestone, Old Red Sandstone, porphyry with green and red spots, Lias with lines of carbonate of lime, Forest-marble, and jasper. Parts of the Bank are broken into gulleys by the infiltration of water, and the subsequent hydrostatic pressure during heavy seas. A large map of the locality, and diagrams showing the dimensions of the Bank, as determined by Mr. Coode, the Engineer of the Portland Breakwater, were exhibited. The questions then discussed by Mr. Tomlinson were—1. Where do the pebbles come from? 2. What force transferred the pebbles from a distance? 3. What force retains them in their present position? 4. Why do the largest pebbles travel to the greatest distance? Mr. Coode's investigations were several times referred to, as well as those of Mr. Palmer and others, on moving shingle, and the importance to the engineer of ascertaining the laws which govern it.

After the reading of the paper, a lively discussion followed, in which a large number of the Associates took part. The President summed up, and Mr. Tomlinson replied at some length. He recommended that one of the next Summer-trips of the Association should be to the Chesil Bank, and that in the mean time a Committee should be appointed to draw up instructions for the visitors as to what points require to be carefully examined before all the questions raised on the subject could be considered as settled.—J. C.

ROYAL GEOLOGICAL SOCIETY OF IRELAND.—There was a general meeting of the Society on the 14th December, in the Museum Building, Trinity College. The chair was taken by the Rev. Dr. LLOYD, the President. The Rev. Dr. S. HAUGHTON read his paper on the *Geology of some of the Western Islands of Scotland.* He said that the following brief notes, mineralogical and geological, made during a yachting-cruise in the West of Scotland, on board Mr. Graves's yacht 'Ierne,' in the summer of 1864, may be of the more interest to the R. Geol. Soc. of Ireland, in consequence of the close relation between that part of Scotland and the North of Ireland.

Crystalline White Limestone of Iona.—On the 17th of July we visited the metamorphic white limestone of Iona, described by Jamieson and others. It bears N. 15° E. by compass, and dips 80° E., and is from 40 to 50 feet in thickness. It is pure white, and has a remarkably flaky appearance, fully explained by its mineralogical composition. On being analyzed, it was found to consist of 71 per cent. of dolomite, and 29 per cent. of a silicate, which proved to be a variety of tremolite. At the time of our visit it was nearly high water, and we were therefore unable to examine that portion of the limestone, exposed at low water, which is said to pass into 'verde antique,' of which, indeed, we found several rolled pebbles on the strand.——*Labradoritic Syenite of Loch Scavig, in Skye.*—We visited the remarkable mountains that surround this wild loch on the 3rd of August, and brought away with us very good specimens of the syenite of which they are composed. The mass of the rock is a medium-grained syenite composed of augite and labradorite, and was particularly interesting to me, because I had failed to find this rock in Donegal, although there are specimens, collected by the late Mr. Townsend, C.E., probably from Donegal, in the Geological Museum of Trinity College. Beds of metamorphic rocks, in which labradorite forms an essential constituent, are well known to form an important part of the Laurentian system in Canada, and I was therefore glad to have an opportunity of examining a similar rock *in sitû* in Scotland. The syenite is bedded, and evidently metamorphic, and is penetrated frequently by dykes of similar syenite, sometimes finer, sometimes coarser in the grain. In the coarsely crystallized masses, the labradorite and augite acquire large dimensions, and are associated with a considerable quantity of ilmenite, such as is found in the oligoclasic syenite of Horn Head, in Donegal. ——*Granite of Ross of Mull.*—On the 17th of July we visited the celebrated granite-quarry of the Ross of Mull, from which it was proposed to obtain the monolith in honour of the late Prince Consort. The granite is coarse, with quartz abundant, and only one felspar, namely, a pink orthoclase, with a little black mica. Its analysis shows that it differs much from the granite of Strontian,* two analyses of which were published by me in the 'Quarterly Journal of the Geological Society of London,' in Part IV. of my 'Experimental Researches on the Granites of Ireland.'——*Gryphæa-beds of Loch Aline.*—On the 15th of July we visited these beds, and found them to consist of decomposing dark beds of shaly limestone, at the sea-level, abounding in ***Gryphæa incurva, Pecten æquivalvis***, and *Lima*; above the limestone lie thick beds of white sandstone without fossils; and this again is covered by thick masses of tabular basalt.——***Tertiary Leaf-beds of Ardtun Head.***—On the 18th of July we rowed across from Iona Bay to Ardtun Head, and were shown the Tertiary leaf-beds by Mr. Campbell, who kindly provided us with blasting-powder and jumpers, by means of which we succeeded in obtaining some excellent specimens of ***Platanus Hebridicus*** from the bed of shale that underlies the bed of conglomerate formed of Chalk-flints and Chalk-pebbles.——***Lias &c. of Pabba.***—We visited the Island of Pabba on the 1st August, and brought away, by diligent quarrying, a good collection of fossils. These were kindly examined and named for me by Mr. Baily, Palæontologist of the Geological Survey of Ireland, who possesses special knowledge of these fossils, from the fact of his having assisted Professor E. Forbes in the determination of the Oolitic fossils found by him at Loch Staffin, in Skye.——***Oolite of Mull.***—On the 5th August we landed at a new locality for fossils on the east side of Mull, pointed out to us by Mr. Campbell, of Aros, Tobermory. We found shale-beds at the sea-level, converted into flinty hornstone of a greenish colour by enormous masses of amorphous trap that covered them; and it was with much difficulty we brought away the few fossils we quarried out, as there was a heavy sea running on the shelving rocks, and our 'gig' was in some danger of being stove in.

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* One of these granites is published, on the authority of Sir R. Murchison, as from Tobermory; but I believe it was originally a specimen from Strontian, and was brought to Tobermory as a building-stone.

Mr. BAILY remarked that, as observed by Professor Haughton, he lithographed the Oolitic fossils from the Isle of Skye, described by Prof. E. Forbes, and obtained from both freshwater or brackish and marine deposits; those collected by Professor Haughton were entirely marine. He also drew the fossil plants from the leaf-beds of the Isle of Mull, believed to be of Miocene age, for the Duke of Argyll. The drawings and Prof. Forbes's descriptions were published in the Quart. Journ. Geol. Soc. London, vol. vii. He considered the value of such a set of fossils as those collected by Prof. Haughton to be greater than perhaps might be supposed, in supplying us with additional evidence of the existence of the Oxford Clay at several localities (including Pabba and Mull) in the Western Islands of Scotland:—***Serpula vertebralis, Rhynchonella lacunosa, Lima lævinscula, Pecten fibrosus*** (?), ***Gryphæa dilatata***, and ***Pinna mitis***, from Pabba; ***Pecten*** and ***Belemnites Oweni*** (?), from Skye.

The CHAIRMAN observed that a high value belonged to the 'azoic' portion of the paper, and especially the discovery of the rock which connected the old world with the new. In reference to the curious little arm of the sea (Loch Scavig) which Prof. Haughton had described, a friend of his, the President of the Royal Society, observed a very singular physical phenomenon on entering that loch at night. There was an aurora borealis, and he distinctly saw the auroral streams issuing from the syenitic rock—an appearance which he was enabled to confirm by changing his place. If it should be established as a fact, it would throw a flood of light ou a very obscure question.

The Rev. Dr. HAUGHTON said he had omitted to state that the geology of the Islands in question derived an additional interest from the observations of General Sabine, to which the Chairman had just alluded, as to the magnetic properties of the rocks. The labradorite- and augite- rock of Skye contained a large quantity of magnetic iron, of a high specific gravity, as he had mentioned, resembling the syenite of Donegal. Colonel Sir Henry James, who had been engaged in investigations for the purpose of comparing the measured arc of the meridian in England with arcs measured in France, Prussia, Russia, and Italy, told him that, on approaching Aberdeen, a deviation of the plumb-line occurred, which he was quite unable to explain. He showed him a specimen similar to the rock now on the table, which contained a large quantity of magnetic iron, and stated that he believed it extended in a broad band through the North of Scotland. It had a specific gravity which was very high, and capable of influencing both the magnet and the pendulum. There were no questions of greater interest in connection with the theory of the earth than those which were opened up and explored by such investigations conducted for the purpose of measuring the arcs of the meridian. Professors Maskelyne, Hutton, and Playfair had been completely baffled in their investigations in connection with the Mountain Schiehallion. He believed the cause to be that they had omitted to take into account rocks of exceptional density, and had in consequence estimated the density of the mountain too low, and accordingly derived too low a density for the earth. There was reason to think that rocks of the character just alluded to ran through Schiehallion. Corrections by modern physicists of their observations went to show, that if they had known what the real weight of Schiehallion was, they would have got at the real specific gravity of the earth. From observations which he himself made at Loch Scavig with a pocket-compass, and also with the compass of the yacht, he was perfectly satisfied that that mountain was what an ancient mariner would have called a loadstone, which was due to the large quantity of magnetic or titanic iron in it.

The CHAIRMAN observed that General Sabine, Professor Phillips, and himself, while engaged in the magnetic survey of the kingdom, made observations and calculations which, when collated, went to show that the magnetic disturbance in England—in which country sedimentary rocks are the most prevalent—was least; that in Ireland was next; and that in Scotland it was the highest of all.

Mr. ORMSBY then made a communication respecting *the Island of Eigg*, of which the following is an abstract:—He remarked that on a recent yachting-visit to the district just described by Prof. Haughton, he had been enabled to confirm his observations as to the Islands being composed of Secondary or Tertiary rocks, capped by basalt. This is to be seen in a very remarkable way in the small Island of Eigg, lying between Mull and Skye. The base of the terraces, or sea-beaches, traceable in going up from the Jail to Sighthill, giving the height of each (from 20 to 189 feet above mean tide-level at Liverpool), and pointing out some of their equivalents on the north and south of the Clyde. Others, also, such as Camphill (211 feet), Queen's Park, the Sandhills of Tollcross, &c., were noticed. In conclusion, Mr. Dougall compared some of the levels now obtained with those given by Mr. R. Chambers, in his 'Old Sea Margins.' While some coincide strikingly, in others the discrepancy is so great that it cannot be attributed to the operation of the causes in which terraces have their origin. He was therefore forced to conclude that the figures given by Chambers in these cases were merely approximations. It was proper, however, to state that we have facilities now for ascertaining altitudes which did not exist when he compiled his work. There is now scarcely a bench of land in Scotland where the Ordnance Survey arrow is not carved, thus rendering the task of procuring levels comparatively easy, and the result substantially correct.

II. January 5; the Rev. H. Crosskey in the chair; a lecture was delivered in the Hall of the Andersonian University by Mr. David Page, F.G.S., on 'Geology as a Branch of General Education.' In the course of an eloquent address, he advocated the introduction of the science in question into the curriculum of our schools and colleges, not only as a means of intellectual training, but as a special preparation for engaging in some of the most essential departments of human industry.—J. F.

Liverpool Geological Society, Dec. 13, 1864; Henry Duckworth, Esq., F.G.S., F.L.S., in the chair.—The following papers were read:—1. 'On the ancient Configuration of the Coast of North Wales,' by Charlton R. Hall, Esq. The author described the traditional accounts of the advance of the sea, and the subsidence of an old castle (Llys Helig) in Conway Bay. He had visited the site of this castle, which can only be seen at the lowest tides, and traced the probable outline of the building, but the time the tide allowed was too short for the examination to be very satisfactory.—2. 'On the Geology of the Country around Builth,' by R. A. Eskrigge, Esq. —G. H. M.

Manchester Geological Society.—A meeting of this Society was held, Dec. 20th, Mr. A. Knowles, the President, in the chair. 1. Mr. J. Plant produced a number of bones and teeth of the Mammoth or Elephant, Hippopotamus, and Rhinoceros, found in Staffordshire; as well as of Horse, Ox, and Deer. The Staffordshire historians, Plot and Garner, mention the finding of remains of the Mammoth and Hippopotamus in Staffordshire; and these authorities were quoted by Buckland, Parkinson, and Owen. He (Mr. Plant) had heard that at another Society in Manchester some Elephant bones had been exhibited which were also found in Staffordshire; and it might perhaps be found that the remains now shown were from the same place, if not part of the same animal.—Mr. Binney said that, at a recent meeting of the Literary and Philosophical Society, Mr. Brockbank exhibited some remains of the Mammoth, or extinct Elephant, found at Waterhouse, near Leek, on the border of Staffordshire, in a fissure of the limestone. When Mr. Brockbank laid those specimens before the Literary and Philosophical Society, he stated that he had never heard of such remains having been found in Derbyshire before. Mr. Watson, however, had stated that 100 years before his day the remains of an Elephant were found in a limestone-crevice at Wirksworth. The people resident in the neighbourhood believed the teeth to be those of a giant, whose 'brain-pan' was so large that it would hold two bushels of corn. There was also evidence of the finding of an Elephant's molar at Adlington; and Mr. James Meadows, of Ashton, recently exhibited an Elephant's tusk which he found at Dove-Holes, near Chapel-en-le-Frith. It was true that the evidences of the remains of such animals as the Elephant, Hippopotamus, and Rhinoceros were much rarer on the western than on the eastern side of the island, but the authorities that had been quoted showed that they had once existed.—Mr. J. Plant remarked that tusks and teeth of Elephants were frequently found in Leicestershire.

2. A paper, by Mr. J. TAYLOR, on 'The Pliocene and Post-Pliocene Deposits in the neighbourhood of Norwich,' was read. The paper showed that there was a considerable difference between the Drift in the neighbourhood of Norwich and the Drift near Manchester, where the character of some of the fossils appeared to be more Arctic.—Mr. Binney said that he did not think the fossils alluded to in the neighbourhood of Manchester were of so Arctic a character as appeared to be generally supposed.—Mr. J. Dickinson said that in some respects the paper confirmed views he had previously expressed to that Society, and which led him to think that great changes would shortly take place in the minds of some of the most eminent geologists on important matters connected with the science.

3. Mr. PLANT gave an account of the discovery of a large bed of hazel-nuts, in a fine state of preservation, in an alluvial deposit at Collyhurst, 13 ft. deep, and in a part of the bed of the Irk where the river had once been 500 yards wide. The deposit was composed of sand, gravel, and river-silt, and rested on the Permian sandstone. He believed it to have been quietly deposited; and probably the river had at that point been in the shape of a large lake, surrounded by forests of hazel-trees. He thought that the deposit was of such a character that the nuts had been placed there two or three thousand years ago.—Mr. Binney said he had had evidence of a similar deposit having been made in the valley of the Roach in fifty years, and judging by the remarks of Mr. Ray about the wooded state of the country around Collyhurst, he should think that the nuts were deposited not more than 100 or 150 years ago.—*Manchester Guardian*, Dec. 21, 1864.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY.—The autumn field-meetings of this Society were held in September and October, at Hagley and Great Barr respectively. On the former occasion the principal points of interest were the Permian beds in Hagley Park, and a few antiquities on the route. The latter meeting was for the purpose of examining some beds of Carboniferous Drift on the eastern confines of the coal-field; and also a small patch of Upper Llandovery Sandstone (fossiliferous), which crops out beneath the Woolhope Limestone of Great Barr. A considerable number of fossils were obtained from this rock.

Since the summer excursions, the members of the Society have continued to hold monthly meetings for the discussion of scientific subjects. At the October meeting, a paper was communicated by Mr. H. Beckett, F.G.S., on the 'South Staffordshire Coal-field,' and was continued at the November gathering. At the December meeting, a valuable paper was read from Mr. J. Ward Longton, on 'The Distribution of Organic Remains in the North Staffordshire Coal-field.' Papers have also been read by Mr. Thomas Coomber, Bristol, on 'Mining Schools;' by Mr. W. H. Hayward, on 'Mammalian Remains found near Oldbury;' by the Secretary, on 'The Somersetshire Coal-fields.'

In November the members visited a very interesting exposure of 'Thick Coal,' which was then being got by 'open work' near Tipton, in consequence of the colliers' strike having rendered coal extremely scarce. This is about the only place where the 'Thick Coal' at its outcrop has not been all dug out. A splendid section, showing the coal occupying a total thickness of above 36 feet, and inclined at an angle of about 40°, was laid bare. The outcrop was overlain by 8 to 10 feet of drift-beds, containing numerous fossils washed from the adjoining Silurian deposits.—J. J.

BATH NATURAL HISTORY AND ANTIQUARIAN FIELD-CLUB.—As the title of this Club indicates, its object is to investigate the Natural History, Geology, and Antiquities of the neighbourhood of Bath. To effect this, four excursions are planned for the year, two of which are arranged with a more immediate view to Geology and Natural History; and two are more especially set apart for the Antiquities of the surrounding country. The following are notes of the last two Geological Excursions, which were of peculiar interest.

The First Excursion took place on 7th April to Frome, Holwell, and the Vallis. As this was merely a rehearsal of the same expedition made during the visit of the British Association to Bath, the incidents of which must be still fresh in the memory of many of our readers, it will be sufficient merely to touch slightly on some of the more salient points which render the geology of this neighbourhood so remarkable.

Under the able guidance of Mr. Charles Moore, F.G.S., the peculiarities of the strata were pointed out, consisting of Carboniferous Limestone, traversed by perpendicular dykes of Lias. In an adjoining quarry, several members were successfully engaged in searching for Fish-teeth and other Rhætic remains, in that small infilling of sand and clay which has yielded so fruitful a harvest to the patient researches of the above-named geologist; here it was that he discovered the teeth of *Microlestes*, the little Mammal allied to the Kangaroo-rat of Australia. Leaving Holwell, the Members passed by Nunney Castle, and were conducted through the romantic valley called 'Vallis,' where are a succession of quarries, representing the same geological features as at Holwell; the Lias-dykes, however, in this locality being in some of the sections only a few inches in thickness, and looking more like veins running through the limestone than anything else. Several of these sections represent the Carboniferous Limestone capped unconformably by the Oolite.

The excursion was terminated with a vote of thanks to Mr. Moore for his energetic guidance in this geological labyrinth.

The next Geological Excursion was on August 11th to Burrington Coomb, and across the Mendips to Cheddar Cliffs, by Charter House. Mr. W. Boyd Dawkins, F.G.S., kindly undertook the guidance of the Members this day; and, having first taken them to the cavern on the left of the ascent, explained his views as to the formation of Burrington Coomb, and limestone ravines in general, of which the following is an abstract:—

'When the Mountain-limestone of the Mendip-range was first exposed to atmospheric influences, the rains that descended upon it sank into the joints, and, carrying away portions of the rocks in solution, formed little streamlets, which gradually united until they formed the main stream that flowed through the channel, which is now Burrington Coomb. For countless ages it flowed on through a large cavern, gradually enlarging its bed, while the entrance through which it passed into open day becoming decomposed, and the roof falling in atom by atom, the small ravine grew larger and larger, and crept upwards at the expense of the cavern, until the latter was altogether lost; and thus, in the course of time, the coombs and ravines are formed with which we are all so familiar in Limestone districts.'

In illustration of his theory of the action of water inside caverns, Mr. Dawkins conducted the party, or some at least of those who were sufficiently bold to venture, into the intricate windings of the great Goat Church Cavern, and there pointed out the gradual process of wearing away which is now going on. In one of the many chambers lately excavated by Mr. Dawkins, he showed the spot where he discovered a flint flake associated with the tooth of an extinct animal. The party, having returned to daylight after an hour's absence in the heart of the limestone rocks, were next taken across the Old Red Sandstone axis of the Mendips, to the head of the Cheddar Cliffs; and here, in illustration of the gradual disintegration atom by atom of the outside of the cavern, were shown a good specimen of a coomb in process of formation, the roof gradually falling in stone by stone, and the ravine creeping on and on by slow degrees into the cavern, as the latter yielded to the wearing process of atmospheric agencies.

Mr. Charles Moore, F.G.S, who was also present, conducted the Members to the old worked-out Roman mines at Charter House, where he gave an account of a discovery, made by himself some time ago, of a series of Liassic fossils found in a lead-vein more than one hundred feet below the surface. The vein running through the Carboniferous Limestone, he infers, from the presence of these fossils, that the contents of the fissure were a comparatively recent deposit from a Liassic sea which once covered the Mendips. This most pleasant excursion was brought to a close by an inspection of the Cheddar Cave, and by a vote of thanks being returned to Messrs. Dawkins and Moore, especially to the former, who had contributed so much to the scientific interest of the day's excursion.—H. H. W.

OSWESTRY AND WELSHPOOL NATURALISTS' FIELD-CLUB.—This Society, which has just completed the seventh year of its existence, held a highly successful Conversazione in the Public Hall, Oswestry, on Friday evening, December 30th, 1864. The Society, in addition to objects of Natural History and other Sciences, derived from the collections of its own Members, solicited contributions of a like kind from the general public; and so hearty was the response, that the choicest and most extensive collection of interesting objects ever exhibited in the West-Midland Counties was arranged in the Hall, tastefully decorated for the occasion. Beside the collections of paintings, photographs, antiquities, coins, seals, stereoscopes, microscopes, &c., there was an interesting assemblage of objects illustrative of the Natural History of the neighbourhood. Its Geology was represented by the choice specimens of five cabinets, containing some good Fossils from the 'Bala' Rocks of North Wales, and the 'Upper Silurian' of South Shropshire; together with a series of Fossils from the hitherto almost barren 'Wenlock Shale' of North Wales, including two groups of the beautiful Encrinite *Actinocrinus pulcher* (Salter), exhibited by Mr. D. C. Davies, of Oswestry, who also showed a series of Fossils, from the Sandstone beds of the 'Millstone-grit:' and it may be observed, in passing, that the discovery of fossils in this formation, hitherto considered to be devoid of remains of former life, is one of the good results achieved by local geologists, who are now mostly members of this Society. The Pond-life of the locality was well displayed in three large and several smaller Aquariums. The numerous living Ferns of the Welsh Border were seen in cases belonging to Mr. J. S. Davies, of Oswestry. Some dried plants were also exhibited. The Insect-life of the locality was shown by a well-arranged collection, belonging to Master G. C. Davies, and placed amidst several good general collections. Ornithology was well illustrated by Birds and Eggs. There was a very complete series of the Land and Freshwater Shells exhibited by Mr. Whitwell, of Oswestry. An exceedingly fine stone weapon, dug out of a Saxon battle-field near the town, was lent by Mrs. Aubrey; and it was interesting to trace the resemblance of this British or Saxon weapon with others upon the tables, recently brought from the Society Islands and from Australia. The attendance was good, comprising about three hundred ladies and gentlemen. During the evening the following papers were read:—

'Ornithology;' by the President, R. G. Jebb, Esq. 'How I learnt to See;' by the Vice-President, Rev. W. W. How. 'On some Bronze Instruments recently discovered near Pool Quay;' by the Rev. D. P. Lewis. 'A Quarter of an Hour in Old Oswestry Gravel-pit;' by Mr. D. C. Davies. 'On the new metal Magnesium, with illustrations of the Magnesium Light;' by Mr. Dumville.

Selections of vocal and instrumental music were given during the evening; and refreshments were not forgotten. Occurring, as this Conversazione did, at a season of the year when outdoor Meetings of Field-clubs are impracticable, we commend the example of the Oswestry and Welshpool Club to the attention of those kindred Institutions that have not yet ventured to mix science with pleasure at a large evening entertainment.—D. C. D.

NOTICES OF GEOLOGICAL PAPERS READ BEFORE THE BRITISH ASSOCIATION—*continued.*

ON THE LOWEST BEDS OF THE CARBONIFEROUS SERIES AT CLIFTON NEAR BRISTOL. By W. W. STODDART, Esq., F.G.S.

THE Clifton gorge exposes a section of all the Lower Carboniferous strata, from the Devonian Beds to the Millstone-grit, in an extent of two miles, from Brandon Hill to a few yards beyond Cook's Folly Wood. The Upper Limestone Shales have a thickness of 600 feet. The massive Mountain-limestone next succeeds, having a thickness of 2,000 feet. It extends along the path for nearly 3,000 yards. This distance is owing to the great fault which causes the upper part of the limestone to appear twice over. This fault has a depth of 800 feet, giving a considerable area of broken ground, which consists of Coal-shales, Millstone-grit, &c., contorted in the most extraordinary manner. Beneath the massive limestone lie the Lower Limestone Shales, with an average thickness of 500 feet, and extremely rich in Fishes, Molluscs, Crustaceans, and Echinoderms. Mr. Stoddart had noticed 81 fossil species from these Shales. It was to the lowest 83 feet of these Shales that attention was called, as they appear to settle a question that has arisen for some time past, as to the position of the Pylton and Marwood group, in what were formerly called the Upper Devonian strata. Mr. Stoddart described first, as a convenient starting-point, in descending order, the well-known 'palate-bed.' It is a dark red ferruginous conglomerate of an immense quantity of teeth, spines, and Coprolites of Fishes, with *Brachiopoda*, *Pteropoda*, *Polyzoa*, &c. It is from four to six inches thick, and lies upon 18 inches of soft friable marl. The principal fossils obtained from this bed are: *Fenestella* (two or three species), *Ceriopora rhombifera*, *Spirifera bisulcata*, *Sp. glabra*, *Discina nitida*, *Lingula mytiloides*, *Conularia quadrisulcata*, *Cladodus conicus*, *Chomatodus linearis*, *Ctenacanthus tenuistriatus*, *Helodus* *lævissimus*, *Psammodus porosus*, and Coprolites. Under the abovementioned soft marl come three beds of red crystalline limestone, exactly similar to each other in lithological character; but the upper and lower are unfossiliferous, while the middle bed is one of the most extraordinary assemblages of fossils perhaps ever seen. It is 8½ feet thick, dipping SSE. at an angle of 68°, and is probably that mentioned in Mr. Williams's section as No. 420. This must have been one long-continued deposit, from its great thickness, and from the fact of not the least 'bedding' being visible, only the usual joints of the limestone. A very singular circumstance is, that a piece broken off from any portion of the bed exhibits the same number of fossils, all small, ranging in size from 1-100th to 1-20th inch in diameter. The only fossils of a larger size yet found are a single specimen of *Spirifera*, a small tooth (*Psammodus porosus*), and a small Spine. The absence of alumina is very remarkable; because so great a quantity is usually present in the Lower Limestone Shales above and below this bed. The fossils are casts, or rather pseudomorphs, composed of a peculiar combination of peroxide of iron and silica; they are very brittle, porous, and insoluble in cold nitric and hydrochloric acids. The calcareous cement being perfectly soluble in these acids, the fossils are easily obtainable. About one-third consist of the most exquisite casts of Infundibulate Bryozoa, showing the cells and other details in a very beautiful manner; a great part of the remainder are casts of Encrinital Ossicula, with a few pelvic plates corresponding to those of the genus *Poteriocrinus*. Numerous casts of two species of *Entomostraca* also occur, which show the hinge-structure very distinctly. The immense mass of fossils in this bed is almost incredible; taken from any part, they form at the very lowest estimate 20 per cent. by weight of the entire rock. From an avoirdupois-pound were obtained 1,600,000 specimens, besides a large quantity of broken shells and other débris. It was probably not a bed deposited in the usual manner, but rather a bank in the Carboniferous sea, exposed to the gentle action of littoral waves. Analogous cases may be seen now going on;—for example, on the coast of Sussex (near Selsea), and on the west side of Caldy Island, a deposit may be seen collecting, the similarity of which to that under notice is very striking. After comparing the Lower Carboniferous Shales of Clifton with the descriptions of corresponding beds in Ireland, by Portlock, Jukes, and Salter, and with some of the Devonshire strata, Mr. Stoddart has no doubt of the geological identity of the Moyola, Altagowan, Coomhola, and Marwood groups, and of their agreement with these Lower Shales of Clifton. It is true that none of the larger *Brachiopoda* occur in these beds of the Clifton Shales, but they are likewise wanting in the Irish beds, where the thickness diminishes as towards the North of Derry. Here the Clifton and Irish fossil fauna very nearly agree. On the other hand, where the Lower Shales in Ireland attain a very great thickness, fossils are found identical with those of the Marwood group. This will be rendered more evident by an examination of the accompanying table:—

Fossils	Clifton group	Marwood group	Coombola group	Moyola group
Filicites dichotoma	—		—	
Knorria dichotoma	—		—	
Platycrinus	—		—	
Poteriocrinus	—		—	
Spirorbis omphalodes	—	—?	—	
Leperditia Scotoburdigalensis	—			—
L. subrecta	—			—
Orthoceras gregarium	—		—	—
Naticopsis plicistria	—			—
Cucullæa trapezium	—	—		
C. Hardingii	—	—		
Modiola Macadami	—	—	—	—
Avicula Damnoniensis	—	—	—	
A. —— *var.* elongata	—	—		
A. —— *var.* media	—	—		
Lingula mytiloides	—			—
Streptorhynchus crenistria	—	—?	—	—
Spirifera disjuncta	—?	—	—	—
Sp. bisulcuta	—	—	—	—
Rhynchonella pleurodon	—	—	—	—
Amblypterus	—			—

The question now arises, said Mr. Stoddart, ought these shales to be classed with the Carboniferous or with the Upper Devonian rocks? The Clifton beds, he submitted, clearly declare the former: 1st. On account of the nature of the fossils. 2ndly. From the comparatively large extent of true limestones and shales and marls (nearly 70 feet) before the true Old Red micaceous beds occur, and 100 feet before the first bed of quartzose conglomerate, which, after all, is the most certain mark of the division of the systems; for both rocks and fossils above and below differ entirely in their character. Lastly, Mr. Stoddart suggested, as another view of the matter, that these Shales, which in Ireland reach the thickness of 5,000 feet, may have as much right to be considered as a distinct and intermédiate series as the Rhætic beds, between the Trias and the Lias, which in the Austrian Alps have very little more magnitude.

ON ICE-CAVES. By the Rev. G. F. BROWNE, M.A., of St. Catherine's College, Cambridge.

MR. BROWNE has recently visited, in various parts of the Swiss and French Jura, the Vosges, and Dauphiné, in places far removed from glaciers, a number of ice-caves exhibiting phenomena of a very remarkable kind, equally interesting to the Geologist, the Physicist, and the Physical Geographer. In large caverns in the limestone, at depths of from 50 to 200 feet below the surface, and from 2,000 to 6,000 feet above the sea, Mr. Browne discovered enormous deposits of ice in the middle of summer; the ice being dense, perfectly crystallized, and evidently permanent, in the form of columns, cascades, and floorings of ice, prismatic in structure, with the axes of the prisms, in the vertical columns, lying horizontal, and in other cases perpendicular to the surface on which the ice was formed. The extent of these caverns was so large, the quantity of ice so great in proportion to the magnitude of the caverns, and the ice had been frozen at so low a temperature—being quite distinct from snow in any of its forms,—that Mr. Browne's attention was forcibly directed to discover, if possible, the cause of the phenomenon. He could find no satisfactory account in any of the works in which ice-caves have been alluded to; although it is evident that similar deposits have been met with in many other districts. They have nowhere as yet been described in any detail, with the exception of the *Glacière* near Besançon, which has been the subject of several communications to the French Academy, and the number is evidently very much greater than had been supposed. They are locally known as affording abundant ice in summer.

It is evident that numerous deposits of this kind cannot fail to have some effect on the caverns, and ultimately on the facilities afforded for natural drainage. Ice, forming and melting, must split still more widely crevices already existing; and sometimes, no doubt, must form fresh cracks. The melting of the ice must carry down to great depths a constant stream of cold water during the summer months, and tend to modify the temperature of the rock, and reduce it below the degree that would otherwise belong to it.

It is by no means easy to explain the origin of these accumulations. They may possibly be portions of old or modern glaciers entering the earth. This suggestion has not yet been verified; nor is it easy always to say whether at one place or other there may not be a communication with the day. That in many cases the ice is pushed forwards and downwards to fill narrow cavities, there can be no doubt; and that glacial effects are thus occasionally produced in the interior of the earth suggests some curious reflections.

The explanations offered and hitherto generally accepted with regard to ice-caves are utterly inapplicable in many of the cases cited by Mr. Browne. Evaporation cannot possibly have produced the effects observed. The accumulation of winter-snows is equally impossible. It remains that the whole of the caves should be re-examined geologically with a view to make out the exact conditions of the case.

ON THE DEVELOPMENT OF AMMONITES. By Dr. T. WRIGHT, F.G.S.

THE analysis of the synonyms of certain species of Ammonites is very difficult, for these fossils have received different names from different writers, quite irrespective of the age, state of growth, or varietal form of the specimen described as the specific type. Not only do these fossils often supply imperfect or fragmentary palæontological material, but many Ammonites have changed their form during growth; therefore the author collected specimens representing the young, middle-aged, and old conditions of as many species as he could get together. The results of his observations on the agreements and differences among these shells in their several stages of growth were given in this paper, prefaced with some remarks on morphological science as illustrated by the *Medusæ*, the *Echinodermata*, and *Crustacea*. The following are Dr. Wright's conclusions:—*Ammonites planicostatus*, Sow., is the young of *Am. Dudressieri*, D'Orb. It has at first smooth ribs, flattened on the back; each rib then developes a spine near the back, which has become bread and flat; the spines afterwards diminish in size, becoming blunt tubercles, and even disappearing altogether in old shells. *Am. semicostatus*, Y. & B., is nearly smooth when young, without the keel or ribs, which are prominent in middle-aged shells. *Am. bifer*, Quenstedt, is smooth when young, acquires ribs when older; and differs considerably when aged, the ribs becoming recurved processes. *Am. Jamesoni*, Sow., is an adult form, with ribs undulating over the back; *Am. Reynardi*, D'Orb., represents the middle age of the same species, with dorsal tubercles on the ribs and no keel; and *Am. Bronnii*, Roemer, is the young form, with ribs, tubercles, and dorsal keel. Lastly, *Am. capricornus*, Schlot., is very difficult to identify in its many forms; indeed, no less than six so-called species have been described out of the various phases of its growth: in early age it is *Am. maculatus*. Y. & B., and *Am. planicosta*, d'Orb.; a little older it is *Am. laticostatus*, Sow.; still older, and when the last whorl has become suddenly enlarged with two lateral rows of small tubercles, it is *Am. heterogenus*, Y. & B., and *Am. Henleyi*, Sow. By a careful study of the morphological characters which Ammonites exhibit, the number of the so-called species will be greatly reduced, and their diagnosis simplified. This will be a boon to the palæontologist, now that the value of Ammonites is more generally recognized; for among all the Invertebrata, they are the surest indicators of the stratigraphical position of the different zones of life in the Secondary rocks.

CORRESPONDENCE.

EOZOON CANADENSE IN CONNEMARA MARBLE FROM THE BINABOLA MOUNTAINS.

To the Editor of the GEOLOGICAL MAGAZINE.

MY DEAR SIR,—I send you two or three slides with films (mounted and ground slices) of the Irish green marble containing the fossil which I suppose to be the same as *Eozoön Canadense*; in fact, I can see no difference whatever. In the hand-specimen, however, the Irish differs much from the Canadian, as the best films are got, not from the banded dark-green, or from that with blue patches, but from the pale-green, translucent, apparently homogeneous portions; that with blue patches showing but little trace of the Foraminiferal structure. The quarry producing the best specimens is that on the north-west flank of the most south-westerly of the Binabola Mountains.* The green marble is found at various points, in a NW. direction, or thereabouts, from this spot; and it apparently forms a bed with a 'strike' of about NW.—SE.; and it rises in many places like a wall above the mica-schist of the country, the latter rock having been more easily denuded. The northern end of the bed is far more calcareous than the southern, and there the Eozoan specimens are very unsatisfactory. As it is many years since I collected my specimens, these notes of the locality are from memory, and may be corrected by later observation. This marble gives way in parts to the action of acid (but not so easily as the Canadian marble that Sir W. Logan gave me), leaving tubuli like a white velvet coating on the cell-masses, and with an occasional thread going right across. It seems as if the carbonate of lime has here been replaced partly by some other mineral, resisting the acid.—Yours very truly,

W. A. SANFORD.

NYNEHEAD COURT, WELLINGTON: *Dec.* 27, 1864.

Note by the EDITOR.

Mr. W. A. Sanford, F.G.S., first wrote to me on November 25, 1864, of his finding Eozoal structure in the Connemara marble; but he did not then feel certain enough of his conclusions to put them in print. When he felt sure, however, of his results, he kindly sent me the 'slides' above mentioned; and having got some pieces of 'Irish Green' from marble-works in London, I verified his discovery by experiment. My specimens, however, of the light-green, translucent, serpentinous marble have yielded much more readily to dilute acid than Mr. Sanford's specimens; and, excepting that the silicate replacing the 'Sarcode' of the *Eozoön* is lighter than in a specimen with which Sir W. Logan favoured me, there is no real difference between the two. The various-formed chambers, the shell of varying thickness,—either very thin and traversed with fine tubuli, the silicate filling which (when bared) resembles white velvet-pile, or thick and traversed with brush-like threads, representing the pseudopodian passages of the 'supplemental shell' (or 'vascular system'),—are all present; though I have not so carefully prepared them as they are shown in specimens of the Canadian Eozoan rock prepared and given me by Dr. Carpenter, whose researches (as read before the Geological Society—see GEOL. MAG. Vol. II. p. 35) have even added to Dr. Dawson's almost exhaustive description (see GEOL. MAG. Vol. I. p. 226) of this fossil. The best way, perhaps, to examine the rock for *Eozoön* is to strike off thin chips of the marble, parallel with a smooth face, cut across the wavy white and green laminæ, as nearly at right angles as practicable (the direction in which ornamental slabs of this marble are often cut), and to submit the chips to the action of very weak dilute acid (not sulphuric); and the peculiar structure, at first sight merely granular (where the mass is more green than white), but showing to the prac-

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* An account of the Geology of the Connemara Mountains, with their beautiful green marble, quartz-rock, and mica-schists, illustrated by a section, may be seen in Murchison's 'Siluria,' 2nd edit. p. 100, &c.—EDIT.

tised eye green stony matter replacing tiers of the many-segmented 'Sarcode,' together with delicate greenish-white threads for 'pseudopodial filaments,' and for 'stolons,' of the different sizes and in the different positions peculiar to the structure of *Foraminifera*, can readily be detected. The loose morsels also, fallen in the water, are (as Dr. Carpenter showed me) especially instructive, if carefully dried and mounted.—T. R. J.

GEOLOGICAL 'NOTES AND QUERIES.'

To the Editor.

MY DEAR SIR,—In the early part of the past year, I ventured to suggest to the Council of that very useful body, the 'Geologists' Association,' that an extension of the aid they were giving to geological observers would result from the periodical publication, monthly or quarterly, of a 'Notes and Queries.' To illustrate my meaning practically, I took the further liberty of contributing the first number, having sundry enquiries myself to make, needing, like others, co-operative help. This little *olla podrida* of mine the Association published, with an official foot-note of approval and explanation. But though still convinced of the value of such means of distributing and acquiring help within the limits of the 'Association,' I am so greatly of opinion that more extended and equally valuable aid may result from embodying the scheme with that of the GEOLOGICAL MAGAZINE, that I beg for some small space wherein to remark upon it. Although a desultory system of notes and enquiries did obtain during the existence of the respected predecessor of the GEOLOGICAL MAGAZINE, the scheme upon which it was cast differed somewhat from the arrangement I would suggest.

My remarks upon the plan need be but short. The arrangement in that valuable friend of Literary men, 'Notes and Queries,' is the one which I should like to see applied to the help of Geological students: everyone being familiar with this model, I need not describe it. My remarks will be rather directed towards indicating subjects which may both lead to the help of individuals, and at the same time advance the progress of the science.

The very suggestive article by Professor Rupert Jones which inaugnrated the New Year, and to which, unknowingly, I added a kind of postscriptal paper, will save me mentioning our wants as regards the palæontological, physical, and petrological studies which belong to the older half of the Palæozoic epoch; and save my bringing forward, as a witness of the usefulness of my plan, any more puzzled student of rocks older than the 'Mid-Silurian' student. At this stage in the chronicle of past time begin my inquiries.

1. Will some one kindly ask what are now the boundaries of the 'Middle Silurian,' and what are its frontier relationships with rocks above and rocks below ? 2. Also whether the May Hill Sandstone, or any 'Llandovery' rock, is being worked now anywhere in Britain ? While making these queries, I call the attention of the Malvern geologists, and other observers situated thereabouts, to the *extraordinary* abundance of *Tentaculites* in the Upper Llandovery Sand-

stone of Ankerdine Hill (south flank), near Bromyard (Herefordshire). A rock literally composed of casts of the sheaths of *Tentaculites* certainly exhibits a curious zoological condition of a Silurian shore.

3. Is the rock of the 'Church-hill quarry' at Leintwardine of 'Aymestry Limestone' age, or 'Lower Ludlow'? I am aware that, until lately, its position as a 'Lower Ludlow' rock was unimpugned; but the discovery of *Pteraspis Ludensis*, the earliest (at present) known Fish, renders it desirable that the question of relative age should be cleared up. 4. Another enquiry, prompted by the fossil contents of a rock exposed near to Leintwardine, I wish also to make, both for my own information, and also as suggestive of research. When are the 'branched Graptolites' discovered some few years ago by Mr. Alfred Marston, in Lower (?) Ludlow rock near Burrington, to be figured, and collated with the species described by Professor James Hall (who certainly is the first geologist who has pieced the fragmentary relics of these curious animals together, and presented us with the entire form) in 'Decade No. 2' of the Geological Survey of Canada? 5. The Ludlow district is so rich in Upper Silurian fossils, that I cannot pass it over, even in thought, without calling attention to some new, large-sized, and certainly undescribed *Pteropoda* from Upper and Lower Ludlow rocks, which are now in the cabinets of my friend Mr. Lightbody of that town. Mr. Henry Woodward has behaved like a father to the Pterygotus family, and I trust he may be inclined to place the Silurian Pteropods in an equal position of comfort and esteem.

6. While remarking upon rocks which lie next above the 'Wenlock Series,' I would suggest that it would be very desirable to tabulate the genera and species of Corals which range upwards from the limestones of that great Silurian zone into the more arenaceous rocks of the 'Lower Ludlow.' Certainly they are but few, and these probably merely the species best calculated, by their life-characters, to live in a changed habitat; but as such study may be taken as one of the many hundred which palæo-zoological science evolves from our ancient rock-material, it cannot be overlooked. 7. Before leaving Silurian palæontology, I should like to express a hope that some record may yet be taken of the most wonderful—for so it was—richness of the comparatively thin band of Lower Wenlock Shales pierced during the making of the tunnel through the Malvern Hills. As yet I have seen no paper describing the fossils, several of which are quite new to Britain, discovered during the progress of the work; and, although the major part of the treasures thus secured are safe in the cabinets of my friend Dr. Grindrod, of Great Malvern, I think some record of their discovery should be drawn up so as to introduce them to their kindred, immortalised in the pages of 'Siluria.'

8. 'The Old Red Sandstone' is a field of enquiry which would easily furnish, of itself, a volume of 'Notes and Queries.' The singularly diverse conditions under which rocks, probably of contemporaneous age, were deposited, and the, as yet, remarkable discrepancies between the palæontological values of rocks lying within its limits, both relatively to each other and with reference to their mineral character,

endow it at once with a special interest. I should like to hear enquiries as to how it happens that, as yet, no remains of any Scotch 'Old Red' Fish have been met with in English 'Old Red' rocks, as exposed in Herefordshire and the Border-counties generally. Also, if Mr. Pengelly's discovery in the Devonshire rocks of Fish-remains allied to the forms met with in the rocks of the Scottish Highlands (Middle Old Red) still stands alone.

9. As regards the uppermost zone of the 'Old Red,'—that known as the 'Yellow Sandstone,' a typical exposure of which was described by Prof. Morris and myself in the Quart. Jour. Geol. Soc., vol. xviii. p. 94, as occurring in Shropshire,—I wish to call the attention of Geologists living in South Wales to its occurrence in the district between Haverfordwest and Tenby; and to the probability of it, as there exposed, yielding good fossils. Specimens of *Pterichthys macrocephalus*, Eg., should be keenly looked for.

10. Questions which arise out of the study of the Carboniferous rocks, and Notes, which I feel sure may be easily gathered, of new discoveries, and fittingly enshrined in the GEOLOGICAL MAGAZINE, are so many, that I will only indicate two matters which, if looked into, and the results preserved, will be of use in the advancement of knowledge. One is, that in the brown shaly coals of North Staffordshire, Shropshire, and West Worcestershire, Reptilian bones occur far more numerously than we have imagined. I have myself, years ago, seen many specimens; but, unluckily, I regarded them as belonging to some Holoptychian Fish, and took no special heed of them. 11. The other subject is connected with one of the mysteries of the Carboniferous epoch; the botanical position of the *Sigillaria* with *Stigmaria* as its creeping root. When possible, it appears to be exceedingly desirable that a careful drawing should be taken of any large individual tree found *in situ*, before the arrangement and relationship of the root with the trunk are disturbed; as there appears some probability that the huge plant was more nearly allied to the Mosses than we have hitherto considered. Prof. Goeppert has lately figured, in the 'Palæontographica' (vol. xii. pl. 36), the filaments of *Funaria hygrometrica* (a well-known English Moss) side by side with an outspread mass of Stigmarian rootlets.

But as I merely mean these remarks to be indicative of some of the many ways in which a 'Geological Notes and Queries' would be useful, I need not add to the few examples I venture to offer. Glad of such aid myself, I shall be equally pleased to find that its worth is appreciated by others.

GEORGE E. ROBERTS, F.G.S.

GEOL. SOC., SOMERSET HOUSE: *Jan.* 6, 1865.

To the Editor of the GEOLOGICAL MAGAZINE.

UNFORTUNATELY for our Irish Drift, shells have only been found very rarely, so that we must do without that kind of evidence; but nevertheless the different Drifts are well marked, and seem to correspond with those mentioned by your correspondent, Mr. Maw.

They occur in the following natural order:—

3rd.	Gravels and sands, including Eskers and Kaims	*Post-drift Gravels.*
2nd.	Clay and blocks, usually made up chiefly of the débris of the underlying rocks, but sometimes consisting almost entirely of limestone fragments: in this latter case, the material is locally called 'Corn Gravel'	*Boulder-clay, or Glacial Drift.*
1st.	Gravel, sand, and clay; the last containing fragments of plants, &c. . .	*Præglacial Drift.*

In Ireland I do not remember to have seen a section in which these three kinds of drift are represented, but in many places I have found Nos. 2 & 3, and in a few Nos. 1 & 2. No. 2 is undoubtedly Glacial Drift, as it was deposited from the large sheet of ice that once covered the country; while No. 1 must have been previously deposited by water, or accumulated on the land; and No. 3 was formed from the part of No. 2 that was washed by and deposited in water. In both Nos. 1 & 3 I would expect to find Arctic Shells and erratic blocks, as they were formed in a similar manner to what is now going on in the Arctic and Antarctic Circles. There, in the large fields of ice, the materials for the Boulder-clay are accumulating; while in the seas around gravels and sands, with Arctic Shells, are being deposited; and the droppings from the passing icebergs supply the erratic blocks. If the land is rising, the field of ice, and consequently the Boulder-clay, will extend out over these sand-deposits; but if the land gradually sinks, part of the Boulder-clay will be washed into gravels and sands; and, as they still continue to be in an Arctic sea, there will be similar shells mixed with them, and passing bergs will supply the erratics. If the ice-field does not reach the coast-line, plants, &c. will grow on the intervening land, which will be destroyed and covered up by the Boulder-clay, if there be a continuation of severe seasons, and the ice-field extends beyond its usual limits. Recently I have found a section in the Balcyneenadouish River-valley, near Gort, Co. Galway, in which there is Præglacial Drift, under about twenty-five feet of Boulder-clay. The Præglacial Drift consists of clay and fine sand, and contains sticks, fir-cones, &c. This section I hope fully to describe in a forthcoming memoir of the Geological Survey.

In the *Præglacial Drift* I have never found striated blocks; but I do not say that they do not occur, as they might have been dropped into it from passing bergs. The surface of the rocks under it I never found polished or striated; but, when the true *Boulder-clay* lies without any intervening rubble, the rock-surfaces are always polished and striated. The *Post-drift-gravels* may lie on a 'dressed' rock, but the polishing and striæ are always obliterated; rounded blocks may also occur in it; but the polishing and scratches are always more or less obscure, and never have the fresh look of the blocks out of the *Boulder-clay*. In this communication I have repeated part of what I formerly said, but I considesed it best to enter fully into the subject.—Yours, &c. G. HENRY KINAHAN.

GALWAY: *Dec.* 5, 1864.

MISCELLANEOUS.

HOW THE SKULL OF THE MAMMOTH WAS GOT OUT OF THE BRICK-EARTH AT ILFORD. By H. WOODWARD, F.G.S., F.Z.S.—In reply to the Rev. O. Fisher's enquiry (see p. 44), having been present during the exhumation of the cranium of the Mammoth (*Elephas primigenius*) at Ilford (described and figured in the GEOLOGICAL MAGAZINE for November, p. 241), I will state the method adopted by Mr. W. Davies, of the British Museum, assisted by Mr. Thorn and others.

We sent down a one-horse spring-van, carrying a good supply of the best plaster of Paris (1 cwt.), six pieces of ½-inch nail-bar-iron, 6 to 8 ft. long, a bundle of splines, a box full of hay and tow, some strips of old canvas, whitey-brown paper, two large earthen pans in which to mix the plaster, spades, trowels, a saw, iron hammers, spatulæ, &c., good stout cord and rope, deal planks, and a hand-barrow upon which to remove the remains, and some large wooden trays in which all the loose portions were to be systematically placed, and marked with pencil on separate papers to show the parts to which they belonged.

You must imagine the skull resting half exposed in compact brickearth, requiring a spade or trowel to remove it, but the fossil itself as friable as decayed wood or tinder, the ivory of the tusk being equally soft and shattered.

The first operation was to remove as much of the soil as could be done with safety; the whole tusk was then covered with sheets of whitey-brown paper; a coating of well-mixed plaster of Paris was placed over the paper covering the tusk, and allowed to settle down upon each side in the grooves which had been scraped in the brick-earth, forming a coat, of this shape Ω, over the entire length of the tusk. When the plaster had set, two bars of the iron (above mentioned), which had been bent to the proper curve, were placed upon the hard plaster, and fixed to it with another coating of fresh-mixed plaster of Paris.

When these coats had properly set, the base of the tusk (which had been carefully cleared and coated all round with plaster) was sawn through a few inches below the socket, the tusk was burrowed under at intervals with the trowel, and hand-holes thus made beneath it, through which were thrust strips of canvas and pads of tow or hay, until the whole was swathed with bandages of canvas, hay, and cord, like a mummy. When thus secured, six men turned it gently over from its matrix and placed it upon a long plank prepared for it (the curved part being supported and fixed with packing), and so transferred it to the van. The second tusk (removed a week later) was raised in a similar manner.

The treatment of the skull was much after the same fashion, except that a coat of fine tenacious clay was used to fill up the nasal apertures and cracks. Over the first coat of plaster, laths and soft iron bars, bent to the curve, were fixed as in the case of the tusk to give rigidity to the whole. As the matrix was removed, pieces of wood were packed under with soft hay to support the head, which being filled with brickearth and sand, was very heavy. When quite cleared and secured, it was turned gently over upon a soft bed of hay placed on the hand-barrow ready to receive it.*

The labour and care necessary are immense, but I feel sure that almost any similar fossil remains might thus be secured, provided always the same amount of skill and patience be brought to bear upon the brittle mass.

MINING NOTES.—It is not perhaps sufficiently known that the excavation of hæmatite iron-ore from hollows and fissures of the Mountain-limestone is now carried on to a very profitable extent in the district between Whitehaven and the mountains of Cumberland. It is the common opinion among the local geologists, who have constantly recurring opportunities of observation, that the ore has been deposited by water, and afterwards altered by hot water and steam, or hydro-thermal agency. It is likewise believed that a great part of the ore must have been carried by water from Ennerdale in the immediate neighbourhood. One of the precipices on the south side of Ennerdale Lake is called Iron Crag, and a single adventurer is now carting ore from this crag to the nearest railway-station. The difference between the iron-ore-deposits in the valleys and the *veins* in the mountains remains to be sufficiently investigated. Have the

Langdale Pikes, seen from Blea Tarn. Harrison Stickle is the highest point (2,424 feet).

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* The zygomatic arch invariably falls away from the *cranium*, dividing at its sutures; the pieces should always be sought for in the matrix beneath and taken especial care of.

latter had the same origin as the deposits, and afterwards been elevated? or were they injected from beneath by igneous action or sublimation?—Very lately a hæmatite-mine has been opened near the top of a hill in the neighbourbood of the Crinkle Crags, and a little to the south of Great Langdale.—Within the last four months the proprietor of one of the Frizington mines (Whitehaven) has commenced mining operations in the side of the highest Langdale Pike, called Harrison Stickle. A *slide* from the Pike down into Langdale is in progress; and an experienced miner, belonging to the Frizington district, assures me that the Langdale Pike will very soon become disfigured, in a few years greatly mutilated, and in course of time perhaps demolished! Now this Pike is well known by tourists to be the chief attraction of the prospect to be obtained from the eastern shore of Windermere Lake.—In the wild and little-known valley called Greenburn, between Little Langdale and the mountains called the Carrs, a copper-mine belonging to John Crossfield, Esq., of Ambleside, was lately abandoned. A Scotch gentleman has purchased the 'plant' within the last year, and by this time has probably commenced reopening. I have been informed that he hopes to be able to meet with granite at an accessible depth, his belief being that the nearer to granite, the greater is the chance of finding copper. Is it so?—D. M.

A BUST of WILHELM HAIDINGER, Director of the Geological Survey of the Austrian Empire, is to be placed in one of the Saloons of the Imperial Geological Institute of Vienna, on February 5th. Very many of his friends and admirers in all parts of Europe, in England, and abroad, have united in offering this compliment to the veteran Geologist and Mineralogist by voluntary subscription.

A VERY fine specimen of Jade or Nephrite, from Battugol, Mont Saians, Irkutzk, Siberia, weighing about 5 cwts., has just been consigned to Mr. Bryce M. Wright, of 36 Great Russell Street, Bloomsbury. It is of a fine dark-green colour, and is the second largest specimen of this mineral in this country.* It was from Nephrite that the most highly-prized hatchets of the aborigines of the Pacific and of the old Swiss Lake-dwellings were wrought. A notice of some Chinese and New Zealand Nephrites is given in the GEOL. MAG., Vol. I. p. 143. The specimen is now upon view.

OBITUARY NOTICE.—Professor BENJAMIN SILLIMAN, M.D., LL.D., died at New Haven on the 24th November last, aged 84. He graduated at Yale in 1798; studied law, and was admitted to the bar in 1802. He afterwards accepted the Chair of Chemistry, Mineralogy, and Geology in Yale College; and in 1820 visited Europe to prosecute his studies in sciences which were at that time almost unknown in America. He returned after an absence of fourteen months, and published in 1821 an interesting 'Journal of Travels in England, Holland, and Scotland.' He revisited this country again in 1851; and again printed his notes, entitled 'Narrative of a Visit to Europe in 1851' (2 vols. 8vo.). In 1807, he made an analysis of a meteorite of great size and brilliancy which had burst in the town of Western, Connecticut; and afterwards assisted Dr. Ware in his experiments with the oxy-hydrogen blowpipe, to which he gave the name of 'compound blowpipe,' by which it is commonly known. It 1818, Professor Silliman founded the 'American Journal of Science and Arts,' now known all over the world as 'Silliman's Journal.' The United States possessed, some forty-six years ago, but one single scientific periodical, the 'Journal of Mineralogy,' and that was but short-lived. On its extinction, Professor Silliman, for the honour of his country, threw himself into the breach, and published in 1818 the first number of the Journal which now bears his name. His remark was—we quote from 'Trübner's Bibliographical Guide to American Literature'—'I feel that this work will absorb my whole life.' And he was not mistaken. . . . 'An ardent promoter of science, he continued to give lectures long after he had resigned his professorship. He was a man of simple tastes, and reached a good old age with mind and body both in full activity. To the very last, we read, he took a deep interest in the progress of science, humanity, and freedom all over the world.'—*The Reader*, Dec. 17, 1864. Prof. Silliman, we may add, was a fine, frank, friendly man; about 5 ft. 10 in. in height, rather spare in body, with oval-longish face and well-formed features, shrewd, open, and intelligent in expression. His quiet engaging manners, his delight in obliging, and his multifarious knowledge, rendered him widely popular. He was a Foreign Member of the Geological Society of London.

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* The largest specimen is in the British Museum, and was brought by M. Alibert, from the same locality, for the International Exhibition of 1862.

We also notice with regret the death of Monsieur Nicolas Robert Bouchard, who expired at Boulogne-sur-Mer in France, on the 22nd of November, 1864, aged 63. M. Bouchard was distinguished for his great acquirements in the sciences of Malacology and Palæontology. During the year 1833–34, he published several valuable memoirs relating to the Mollusca and Crustacea living on or near the shores of the Boulonnais. In 1838 he commenced his geological and palæontological researches; and at the period of his death had assembled a most remarkable and valuable collection of fossils, and especially of those that occur in the various geological formations of the Department of the Pas-de-Calais. In his memoir on the Devonian rocks and fossils of the Boulonnais, published in the 'Bulletin de la Soc. Géol. de France' for 1840, Sir R. Murchison does not fail to refer to M. Bouchard's researches, and adds, that they have materially tended to assist him in arriving at a positive determination of the true age of the Devonian rocks of that part of France. M. Bouchard had also devoted many years to the study of the Brachiopoda, upon which subject he published several papers. It is to him we are indebted for the establishment of the genus *Davidsonia*. His last memoir bears for title, 'Observations sur les Hélices Saxicaves du Boulonnais;' it will be found in the sixteenth volume of the 'Annales des Sciences Naturelles' of Paris.

During many years M. Bouchard was one of the directors of the Museum of Boulogne-sur-Mer, and has always been ready to assist others, and to impart the knowledge he had himself acquired after forty years of the most persevering researches.—T. D.

THE

GEOLOGICAL MAGAZINE.

No. IX.—MARCH 1865.

ORIGINAL ARTICLES.

◆

I. ON THE LAURENTIAN ROCKS OF BRITAIN, BAVARIA, AND BOHEMIA.

By Sir RODERICK I. MURCHISON, K.C.B., F.R.S., Director-General of the Geological Survey of Great Britain, &c. &c.

A LARGE portion of the last number of the Quarterly Journal of the Geological Society (February 1st) is justly devoted to the important subject of the Laurentian or oldest known stratified rocks, the elaboration and naming of which in North America were, it is well known, accomplished by Sir William Logan and his associates. On this occasion a memoir by that eminent geologist naturally leads the way, whilst, in the subsequent articles, the nature and structure of the *Eozoon Canadense*, which has been found in these rocks, are ably developed by Drs. Dawson, Carpenter, and Sterry Hunt.

The British rocks which I have shown to be of Laurentian age occupy striking headlands in Sutherland and Ross, where they are, as I proved, unconformably surmounted by both Cambrian and Lower Silurian rocks. At first I termed these lower rocks 'Fundamental Gneiss.' They were then described as being completely dissevered from all the palæozoic rocks, not only by unconformability, but also by having an entirely divergent strike or direction, namely, from SE. to NW., being *at right angles to that of all the superjacent deposits* of Britain. The announcement of a direction from SE. to NW. in these underlying rocks was in itself as great a novelty in our insular geology as the introduction of a lower base of our whole geological series than had hitherto been recognized.

After several years of preceding researches, I brought these data definitely before my associates in 1858, when I termed these lowest rocks 'Fundamental Gneiss;' a name intended to mark that which was unquestionably a new base for the whole stratigraphical series of our country. So truly was this the case, that, in the order of superposition fixed upon by my predecessor Sir Henry De la Beche, when Director-General of the Geological Survey, and since approved by myself, after consultation with Professor Ramsay and Mr. Jukes, the Cambrian rocks, altered and unaltered, were placed at the base of the whole sedimentary series, and the letter *a*, as the beginning of the alphabet, was affixed to them.

The fact of the existence of this older or basement formation in the North-west of Scotland was again pointed out by me* in the following year in a new edition of 'Siluria.' I also prepared a geological map of the Highlands,† in which to the term 'Fundamental Gneiss' was added, 'or Laurentian of North America.' For when I first ascertained this order I was unaware of the results of the labours of Sir W. Logan; but, in the following year, having induced Professor Ramsay to accompany me, to make sure of the existence of this striking new feature, he not only confirmed the accuracy of my sections and descriptions, but assured me that my 'Fundamental Gneiss' was unequivocally the Laurentian, he (Prof. Ramsay) having recently explored the Canadas in company with Sir W. Logan. From that moment, wishing to do all honour to the distinguished Director of the Canadian Survey, I used the term 'Laurentian,' both in the memoirs by Mr. Geikie and myself, and in our Geological Map of Scotland.

I call the attention of geologists to these facts because, although Sir W. Logan himself has done ample justice to this piece of work, and has spoken of it as the first correlation of the Laurentian rocks of Britain with those of America,‡ I regret to perceive that, in the new edition of the 'Elements of Geology' just issued, Sir Charles Lyell thus dismisses the subject of the Laurentian rocks of Britain:—'The oldest stratified rock in Scotland is that called by Sir R. Murchison "the Fundamental Gneiss," which forms the whole of the island of Lewis in the Hebrides. On this gneiss, in parts of the Western Highlands, the Lower Cambrian and various metamorphic rocks rest unconformably. It is conjectured that this ancient gneiss of

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* Quart. Journ. Geol. Soc., vol. xv. p. 353.

† Ibid., plate 12.

‡ See Sir W. Logan's remarks on this point in the last number of the Quart. Journ. Geol. Soc., vol. xxi. p. 46.

Scotland may correspond in date with part of the great Laurentian group of North America.'[*]

Now I think that the labours which, according to the subsequent surveys of Ramsay, Harkness, James, and Geikie, as well as the opinion of Sir W. Logan, 'established for the first time' a Laurentian equivalent in the British Isles, or, in other words, a new base for all our series of deposits, were something more than a *conjecture.* A Laurentian base became an established fact, and, as such, has been laid down on our geological maps. Hence all young geologists, who take their belief from these 'Elements,' ought, I submit, to have been made acquainted with it. For, although previous geologists had treated of this gneiss, they had not shown that it was entirely distinct from all the superjacent and younger gneiss, now shown to be of Cambrian and Silurian age, nor had they indicated the remarkable fact of the entirely divergent direction of its strata.

I can only account for Sir Charles Lyell's having regarded the establishment of the existence of Laurentian rocks in Britain as a 'conjecture,' by supposing, that of late he has been so absorbed in the production of his last remarkable work 'The Antiquity of Man,' that he has failed in paying sufficient attention to the progress of discovery in our islands at the other end, or beginning, of the geological scale. In his Address to the British Association at Bath, he naturally revelled with delight on the discovery of the *Eozoon Canadense* in the Lower Laurentian rock. Let me say that I rejoiced with him; for there was nothing in the finding of *one of the lowest orders of animals in the lowest known sedimentary rock* which in any degree interfered with my views of a succession from lower to higher animals, in succeeding deposits, as founded on all our existing knowledge. On the contrary, this discovery seemed to me to confirm that view; and Sir Charles rightly declared, that thereby the word 'Azoic' must be dismissed from our nomenclature. At the same time all old geologists knew that we who used the term 'Azoic' did so solely because at the period of its use no signs of life had *then* been found in these lowest rocks.

And here I also rejoice to find, by reference to the last number of the GEOLOGICAL MAGAZINE, that one of these low organisms, identical indeed with the *Eozoon* of Canada, has been found, by Mr. W. A. Sanford, in the green serpentinous limestone of the crystalline rocks of the Bins of Connemara, in the North-west of Ireland. This fact, affirmed as it is by separate experiments of Professor Rupert Jones, is of exceeding interest; and, combined with the geological sections of those mountains which I published in 'Siluria' (p. 100), assures us that, in the North-west of Ireland, as in the North-west of Scotland, we have a true Lower Laurentian rock. Indeed the mineral characters of the Irish and Canadian rocks are also assimilated by containing much serpentine.

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[*] Elements of Geology, 6th edit. p. 580.

It is also of high geological importance to observe, that the strike of this Irish limestone with *Eozoon* is like that which I described in Scotland, namely, from South-east to North-west. In a communication to the French Academy of Sciences some years ago, I specially called attention to this striking fact—that the direction of the Laurentian gneiss of Scotland was at right angles to that of all the superjacent rocks of Britain, throughout which country the Cambrian and Silurian rocks everywhere trend from NE. to SW.

Finally, as to the Laurentian rocks of Bavaria and Bohemia, which are not noticed in the 'Elements.' In the year 1862 I satisfied myself by personal researches* that the 'Primordial' Silurian zone of Barrande was, in Bavaria and the adjacent parts of Bohemia, underlain (as shown by Gümbel) by a very vast thickness of clay-slate, which, though not so much altered as the overlying strata containing fossils, had as yet afforded no traces of them. It was underneath these vast masses, united with subjacent metamorphosed crystalline schists, also of great thickness, and considered, as a whole, to represent the Cambrian rocks, that the grand mountains of an older gneiss rise up. I had no hesitation, therefore, in referring this ancient gneiss in the heart of Germany, and of which there is a younger and an older mass, to the Laurentian age, as well as the fundamental rocks of Britain above spoken of. If English writers have failed to allude to this great feature in the geological structure of Germany, as proved by order of infraposition (a natural result, indeed, of the previous labours of Barrande and Gümbel), there are authors in Germany who have not failed to record the importance of the conclusion at which I arrived, and which I thus expressed:—

'If all the true gneissic rocks of Bavaria (and Bohemia) be united, they may well, from their colossal dimensions, stand in the place of the Laurentian Gneiss of Canada and of the North-west of Scotland. The clear evidence which exists of the interpolation of a vast thickness of sedimentary formations, in which no fossils have been found, between the great gneissose series and the lowest Silurian rock is a good reason for believing that the gneiss of Bohemia and Bavaria is truly the representative of the Laurentian or Fundamental Gneiss.'*

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* Quart. Journ. Geol. Soc., vol. xix. p. 354, &c.

II.—On a Sudden Sinking of the Soil in a Field at Lexden in Essex.

By the Rev. O. Fisher, M.A., F.G.S.

In the month of May, 1861, there occurred a curious subsidence of the soil in a field on the 'Malting Farm' at Lexden in Essex. The cavity thus produced was about twenty-five yards in circumference, of an elliptical form, and about twenty feet in depth, with the sides slightly overhanging. The subsidence took place quite suddenly; some workmen, who were in the field in the forenoon, finding the pit fresh formed on their return from dinner. The ground in which the pit is situated consists of a slightly rising bank of valley-gravel, and is about fifty yards to the south of the little River Colne, which runs past the spot, and gives its name to the ancient town of Colchester. The surface of the field cannot be more than five or six feet above the stream when full.

The sides of the pit are clean-cut in the gravel, which is stratified and has evidently never been disturbed. Though at the time of the occurrence the event excited great local interest, yet I did not myself hear of it until a year ago. I then found it, after a rainy time, containing a little water at the bottom, in the funnel-shaped cavity which was formed of the impervious surface-soil that had subsided; but it was evidently not spring-water. See the accompanying section.

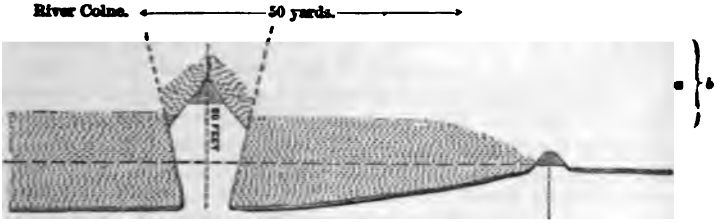

Diagram-section of a Natural Pit near Lexden, Essex.

a. River-level. b. Low-level Gravel (6 feet thick above the river-level).

Such are the phenomena: and the question is, how are they to be explained? The subsoil of the valley is London Clay, which is seen at the bottom of Lexden brick-pit (that cemetery for extinct Pachyderms; see Quart. Journ. Geol. Soc., vol. xix. p. 393), about half a mile distant to the east. It so happens that several Artesian wells have been sunk not far off, so that we know the sequence of beds in the neighbourhood. The late Mr. J. Brown, of Stanway, supplied me with the following section of the well at the Colchester Water-works, which is situated on the edge of the same valley a mile to the east.

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* Quart. Journ. Geol. Soc., vol. xix. p. 359. Looking to the total divergence of their strike, I am of opinion, that the Laurentian rocks of the North-western Highlands, as well as those of the North-west of Ireland, will prove to be the 'Lower Laurentian' of Logan.

Section of the Artesian Well at the Colchester Water-works.[*]

Vegetable soil and low-level gravel . . .	12 feet.
London Clay, with much green sand in the lower beds	105 „
Woolwich and Reading beds	25 „
Chalk, bored	152 „
Plenty of good water at	294 „

At another well, which was commenced, but abandoned, at the Cavalry-barracks, about two miles to the south-east of the subsidence, the thickness of the London Clay and Lower Tertiaries was found to be 211 feet, and the Chalk was reached at 237 feet.

Noticing that at the water-works the Chalk was reached at 142 feet, this gives the difference of depth for the top of the Chalk, at the two localities, as 95 feet, which must be very nearly the difference of surface-level of the two places. This shows that the surface of the Chalk is, in all probability, nearly horizontal, and consequently deeply covered by clays at Lexden. We are precluded, therefore, from attributing the subsidence to an ordinary pipe in the Chalk,[†] for such could not have been formed beneath so great a thickness of clays. Had Chalk been the immediate subsoil, such a subsidence might have occurred; for it is probable that the pipes formed by the percolation of rain-water through Chalk are not always filled up by the falling in of the superficial beds keeping pace with the formation of the cavity. The workmen at Horstead Chalk-pit in Norfolk (where the Chalk is wrought beneath a thick covering of Norwich Crag) assured me that they occasionally came upon hollow pipes, roofed over by the 'uncallow,' i.e. the Crag deposits. This is quite probable, on account of the firmly compacted bed of great flints which immediately cover the Chalk. But such an explanation will not apply to our present problem.

That there must be a vacuity somewhere beneath the subsidence is clear. That it should be in the gravel is impossible, because the stratification, as exposed in the sides of the hole for about 10 feet, is perfectly regular; that it exists in the London Clay is also impossible; but that such a cavity should exist in the Chalk is probable. I conceive it may be connected with the chasm from which the supply of water to the Colchester Water-works is obtained.

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[*] I am indebted to Mr. Prestwich for a correction to Mr. Brown's note, as also for the measurements of the well at the Cavalry-barracks.

[†] See the Author's paper 'On some natural Pits on the Heaths of Dorsetshire,' Quart. Journ. Geol. Soc., vol. xv. p. 187.

When the well was bored, the tool, after passing through a layer of flints, sunk suddenly, and the water rushed up with a force that (as the late Superintendent expressed it to me) shook the hill. This shows that the spring is connected with an extensive and free reservoir. There are two other wells, at distances of a mile and a mile and a half, in a straight line east of this one, which are evidently connected with the same reservoir ; for on Mondays, when the pumps are not at work at the Water-works, the water stands higher than usual in those wells. I conceive, then, that the motion of the water in this subterranean reservoir, caused by the draught of water at these wells, disturbed the equilibrium of the roofing of the chasm at a point where it was barely stable, and caused the subsidence in question.

This is rendered the more probable because it is evident that this natural pit is on a line of subterranean drainage, as is shown by the hole being dry at a level lower than that of the river. The water in the Colchester well stands at about 10 feet below the level of the river; which being more than a mile lower down the stream, would give at Lexden a greater difference between the subterranean and surface-drainage levels.

III.—ON THE CRAGS OF SUFFOLK AND ANTWERP. (PART I.)

By E. RAY LANKESTER, Esq.

THE Suffolk Crags.—There are few deposits in this country which form so admirable a field for study as the Crags[*] of Suffolk. Unique as to age, the sole representatives in England of the great Pliocene deposits of Europe, it becomes a matter of very high interest to identify them in any way with particular strata in other countries. The lowest of these Crags occurs in small patches over an area of about eighty square miles, and consists of either loose or compact light-coloured sand, alternating with bands of *Polyzoa*, which sometimes form a kind of limestone. From this Crag 299 species of *Mollusca* have been obtained: of these, 148 are extinct, 151 are still living. This so-called 'Coralline Crag'* lies on London Clay, and is seldom more than 20 feet in thickness. The 'Red Crag,' so called from its iron-stained appearance, is an irregularly stratified deposit, composed of rather coarse sand and fragments of shells, abounding also in more perfect remains, but very rarely affording the valves of Conchifera, opposed or *in situ*. It extends over a larger area than the Coralline Crag, abont 200 square miles, part of which is in Essex. The Red Crag, rarely exceeding 20 feet in thickness, in most localities rests on the London Clay, the Lower Crag having probably been denuded: it is occasionally, however, found resting on the latter. At the base of both Crags, when resting on the London Clay, a deposit of rounded concretionary nodules, derived from and containing the fossils of the London Clay, is found, and is worked for the nodules, which in great part consist of phosphate of lime, and are manufactured into manure. Associated with these nodules, are teeth of *Mastodon*, *Rhinoceros*, and other Mammals,† which have been derived perhaps from earlier Pliocene, perhaps from Miocene strata, and are similar, in some respects, to those obtained at Eppelsheim in Germany. In addition to these, there are the remains of large *Cetacea*, much worn and rolled, as well as the teeth of the large *Carcharodon* and *Oxyrhina*. These are probably the remains of a *former* Pliocene deposit, broken up like the Miocene beds at the beginning of the Crag era. Similar vertebrate fossils and phosphatic nodules are also dispersed at intervals in the higher strata of the Red Crag. Their occurrence here has led to much confusion, since they have been, and still are by many, regarded as indigenous to the Crag.

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[*] The most important notices and memoirs that have been written on the Crags of Suffolk and Essex are—by Mr. Charlesworth, Proceed. Geol. Soc. 1835, vol. ii. p. 195; Phil. Mag. 1836, 3rd Ser., vol. vii. pp. 81, 465; Report Brit. Assoc. 1836, Trans. Sect. p. 84; by Sir C. Lyell, in his 'Principles' and 'Elements of Geology,' and in the Mag. Nat. Hist. 1839, New Ser., vol. iii. p. 313; Mr. Prestwich, Quart. Journ. Geol. Soc. 1849, vol. v. p. 350; Mr. S. V. Wood's Monograph of the Shells of the Crag (2 vols. 1848-56; Palæontographical Society), and his paper on the Extraneous Fossils of the Red Crag, Quart. Journ. Geol. Soc. 1858, vol. xv. p. 32; and Mr. S. V. Wood, jun., on the Red Crag, Annals Nat. Hist. 1864, 3rd Ser., vol. xiii. Besides the Mollusca, the Cirripedia, Echinodermata, Polyzoa, Corals, and Entomostraca of the Suffolk Crag have been figured and described in the Monographs of the Palæontographical Society. The Crags of Antwerp were treated of by Sir C. Lyell in the Quart. Journ. Geol. Soc. 1852, vol. viii. p. 281, &c.; and several papers on these deposits and their fossils are to be found in the publications of the Brussels Academy, &c. Reuss has described the Foraminifera of the Antwerp Crag in the Proceed. Vienna Acad., vol. xlii., 1860, p. 355, &c.

From the Red Crag 231 species of Mollusca have been obtained, of which 139 belong also to the Coralline Crag; and 92 are found only in the Red Crag. Of the latter group, 42 are extinct, and 50 are still living.

With the Mammaliferous or Norwich Crag, I do not purpose to deal in this paper, as it is a much later deposit.

The Coralline and Red Crags occupy the south-east sea-board of Suffolk and a part of Essex; extending along the coast about twenty miles, and inland twelve miles more or less.

The Antwerp Crags.—If the German Ocean be crossed from Orford on the Suffolk coast in a direction almost due south-east, the mouth of the River Escaut will be reached, on which stands the ancient city of Antwerp, which, always an interesting spot to the tourist, has at the present time an additional interest to such as are students of geological phenomena. Immense fortifications are being placed round the outskirts of the city, forming a semicircle some five or six miles in extent; and the deep trenches have displayed a series of sandy and argillaceous deposits, abounding in fossils, and presenting a strong resemblance to the Crags of Suffolk. How the fortifications of Antwerp are to be garrisoned, or what their ultimate utility may be with the small handful of soldiers which Belgium can supply, unless aided by this country, we need not stop to inquire. Let us plunge at once into the trenches, and examine the section,—a proceeding, by-the-by, strictly forbidden by the Government, and but to be accomplished by the payment of a franc to the sergeant on duty. The writer was enabled in this manner, last summer, to examine the strata in a satisfactory manner, and to form a good collection of their organic contents. As in Suffolk, the Crag-deposits rest on an Eocene clay, and are capped by Pleistocene strata, of an age equivalent probably to that of the Loess of the Rhine. The accompanying diagram will show the arrangement of the various beds. The section is taken from the River Escaut to the Canal de la Campine, a distance of about 19,000 yards; the trenches in front of the eight detached forts, surrounding the line of works, furnishing the data upon which it is constructed. An admirable little paper (presented to the Royal Academy of Brussels) by M. Ad. Dejardin, Captain of Engineers, gives a description of two sections; one passing by the detached forts, and another along the semicircular line of entrenchment. The annexed diagram is constructed from my own observations, assisted by the excellent drawing of the Belgian Engineer. In many places

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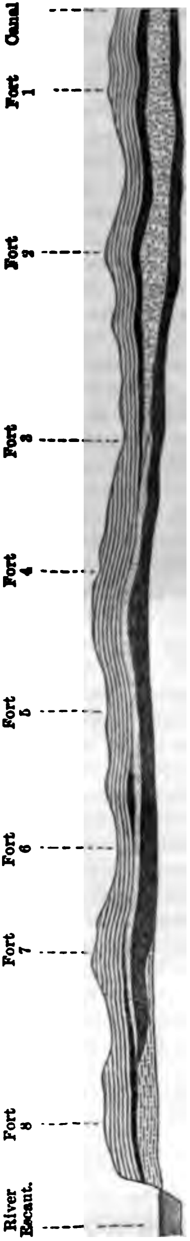
* Of the three recognized divisions of the 'English Crag,' the lowest has been known as the 'Coralline Crag' ever since Mr. Charlesworth so named it in 1835, on account of its abounding with little *coral-like* fossils, which, however, when duly studied, were found to be *Bryozoa* (*Polyzoa*); Corals being exceedingly rare in it. 'Bryozoan Crag' ought, therefore, to take the place of this common misnomer; but 'White Crag,' or 'Lowest Suffolk Crag,' are better names for this division, and already in use.—EDIT. GEOL. MAG.

† It appears from the researches of Dr. Falconer, that these fossils are identical with Sub-Apennine forms: others, however, consider them of Miocene age. Whichever is the correct view, there is no doubt that the fossils are *extraneous*, and derived from earlier beds.



Section along the Trench from the River Escaut to the Canal de la Campine. (About 19,000 yards in length.)

▤ Pleistocene. ▨ Middle Crag. ■ Lower or Black Crag.

■ Upper Crag. ▨ Unfossiliferous Green Sand. ▦ Eocene Clay (Système Rupélien).

The bottom of the Trench is uneven, as represented in the section. (See foot-note, p. 106.)

there are gaps where strata are wanting; and very rarely do the various beds rest conformably one on another.

Overlying the Rupelian or Eocene Clay, above mentioned, which is rarely exposed in the diggings, is a fine black sand, enclosing a very great number of fossils, which have a grey tint. All the Shells contained in this bed are perfect, many being closed Bivalves; the stratification is very even; and altogether the sand bears indication of having been quietly deposited. The immense abundance of the valves of a variety of *Pectunculus glycimeris*, a common fossil of the Coralline Crag, and represented by a noticeable variety (*subobliquus*) in the Red, is truly surprising; in fact, I have never seen so many Oyster-shells in a fishing-town, as I saw *Pectunculi* here. *Venus casina*, *Cardita senilis* (?), *Astarte*, *Nucula*, and a Volute, somewhat similar to *Voluta Lamberti*, are amongst the most conspicuous *Mollusca*; while *Naticæ*, *Pleurotomæ*, *Scalariæ*, *Fusi*, and others, are not uncommon. With these is associated a beautiful Coral, of the genus *Stephanophylla*, as well as *Polyzoa* (*Lunulites*, *Flustra*, and others). The Black Crag occupies by far the greater extent of the fortifications, in the formation of which many new species have been discovered. Above the Black or Lower Crag exists a bed of fine green sand, generally unfossiliferous, more particularly developed on the southern side of the works. In certain spots, however, a new species of *Ostrea* and a *Terebratula*, which may perhaps be considered as a variety of the well-known *T. grandis*, *variabilis*, *spondyloides*, vel *Sowerbii*, are found, as well as a few fossils of the Black Crag. This bed must therefore be regarded as a member of the Lower Crag; the change in its palæontological aspect resulting from some corresponding alteration of the level of the sea-bottom. Succeeding the green and black beds, is a grey bed, containing fossils of a much more recent aspect than most of those of the Black Crag, and therefore considered as a distinct deposit. This Middle Crag contains *Cyprina rustica*, *Astarte Omalii*, and numerous *unrolled* and well-preserved Cetacean remains and teeth of Sharks. Above this comes a yellowish-brown argillaceous deposit, of considerable thickness,* containing fossils of yet more recent form.

The yellow or Upper Crag contains *Cyprina rustica* and *Pecten maximus* abundantly, *Astarte mutabilis*, *Cyprina Islandica*, *Nassa labiosa*, *Lingula Mortieri*, and *Voluta Lamberti* of the typical form, also Cetacean and Fish-remains. The teeth of a species of *Phoca* have been described by M. Van Beneden from the Upper Crag also. Above the Upper Crag is a Pleistocene deposit, which forms an excellent parallel to the Pleistocene beds capping the Red Crag of Suffolk.—(*To be continued.*)

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* It is impossible to estimate correctly the depth of any of the strata, as the trench varies much in depth itself. It is in most places 9 metres (29½ feet); and a glance at the section will show the relative amount occupied by each bed.

IV. THE FOSSILIFEROUS CHARACTER OF THE MILLSTONE-GRIT AT SWEENEY, NEAR OSWESTRY, SHROPSHIRE.

By W. Prosser, F.G.S., M.R.C.P.

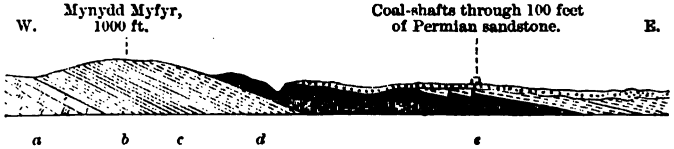
THE Carboniferous rocks of Shropshire possess several peculiar features; and no member of the series shows these in a greater degree than the Millstone-grit, as seen on Sweeney Mountain, near Oswestry. Before discussing these features, it will not be amiss to detail briefly the character of this rock in other localities. It varies considerably in different places. For instance, in the Forest of Dean, it is a hard intractable rock. Such it is also in Glamorgan and Monmouthshire, where it is often seen in place under the Coal-measures, or in boulders on the hillsides. Varteg Hill, near Pontypool, is a most characteristic spot for it; that hillside being covered with masses of grit, of all sizes and shapes. These masses are not unfrequently wholly made up of water-worn quartz-pebbles, occasionally as large as a hen's egg, in a cement of sand and decomposed felspar. And although hundreds of houses, with their garden-walls, have been built of them, yet considerable areas of these boulders remain. Very large blocks of this rock may be seen on the southern flanks of the Black Mountains, Caermarthenshire, above the village of Cross-Inn. The Millstone-grit of the South-Welsh Coal-field, which goes by the name of 'Farewell Rock'—from the fact that the miner on striking it bids farewell to coal, possesses the valuable property of being able to resist successfully for a length of time the action of most intense heat, and for this reason the 'hearths' of iron-furnaces are constructed of it.

In the Warwickshire Coal-field, the Millstone-grit 'consists of a hard siliceous quartz-rock, with thin bands of interstratified shale' (Howell; Mem. Geol. Survey, 1859). In Derbyshire and Lancashire the Millstone-grit series is more varied and extensive; often exhibiting in one section beds of very different lithological characters,—bands of impure limestone, partings of shales, and beds of sandstone, alternating with each other (see Hull and Green, Quart. Journ. Geol. Soc., No. 79). All these kinds of Millstone-grit, however, agree in one particular, namely, that where the calcareous element is absent, the beds are unfossiliferous.

The Millstone-grit of the Flintshire Coal-field, as seen at Sweeney Mountain, near Oswestry, differs from the above-mentioned in being highly fossiliferous. The rocks consist, for the most part, of sandstone, formed of very minute quartz-pebbles in a matrix of decomposed felspar. Many of the beds are soft enough to be broken by the hand, while others have a moderate degree of hardness, and they graduate from cream to chocolate-colour. Some of the harder beds are quarried for general building-purposes; and they are said to possess the valuable property of the Oolite of Caen—that of hardening on exposure to the air. After long exposure, this stone, like the New Red Sandstone of Cheshire, exhibits white crystalline markings, which often stand out in bold relief, like some curious hieroglyphic characters. Whether the Millstone-grit accompanying the whole extent of the Flint Coal-field partakes of the fossiliferous character, the writer is not prepared to state, but he has proved it to be so over a considerable extent of country. In one instance, at least, the grit is absent from the series, namely, at Selattyn, about five miles from Oswestry, where the Coal-shales lie directly and unconformably on the Silurian slate-rocks of Selattyn Hill.*

The Millstone-grit is well developed in several places in the North-west of Salop, and the South-east of Denbighshire. It crowns the summit of that fine escarpment of Mountain-limestone called the Eglwysegle Rocks,' in the Vale of Llangollen. Continuing thence over 'Trevor Rocks,' it appears as a compact, close-grained sandstone at Pont-Cefn; while in the neighbourhood of Oswestry it is seen at Selattyn and Porkington; also on the summits of Cern-y-bwch and Mynydd Myfyr; in both of which localities the beds have a considerable inclination. The lowest members, however, of the formation are best studied on Sweeney Mountain, where they are much exposed, and whence they descend by low smooth undulating eminences to the plain below.

Murchison divides the Millstone-grit of the North-Welsh Coal-field into—1st. 'Light-coloured siliceous sandstone,' forming 'a porous rock, made up of fragments of chert imbedded in a matrix of fine white clay.' 2nd. 'Whitish or pinkish sandstone.' 3rd. 'Other and lower beds, forming the summit of Sweeney Mountain, are coarser, containing distinct pebbles of quartz' (Sil. Syst. p. 144). But, inasmuch as the lithological characters of the same bed vary considerably in different localities, the above triple division is by no means constant over any great extent of country. The following section by Sir Roderick, through the Millstone-grit of Mynydd Myfyr, indicates the relative position of these strata—namely, beneath the shales of the Coal-measures, and above the Carboniferous Limestone (Sil. Syst. pl. 30, fig. 14).



Section of the Carboniferous Rocks near Oswestry. (After Murchison.)

a. Carboniferous Limestone.

b. Red Sandstone.
c. Calcareous Grit.
d. Red Sandstone, Chert, and Grit.
} Millstone-grit.

e. Coal-field of Oswestry. Coal-measures, obscured by gravel.

Murchison was one of the first to notice the fossiliferous character of the Millstone-grit of the North-west of Shropshire; for, in 1839, in his description of these strata, he states that 'Fragments of Encrinites and Corals are also found in these beds' (Sil. Syst. p. 144). About the year 1856 Mr. Meredith, then of Oswestry, now in Australia, found near Sweeney a specimen of *Sanguinolites variabilis* in a mass of sandstone. In June 1859, Mr. D. C. Davies, Oswestry, recognised drifted blocks of Millstone-grit in a Railway-cutting, and found them to contain *Rhynchonella* (see Proc. Oswestry Field-Club). In the autumn of the same year the writer of this paper, examining some heaps of sandstone lying along the roadside near Sweeney Chapel, found them to be teeming with obscure fossils, which Mr. J. W. Salter, F.G.S., afterwards determined to belong to *Schizodus*, thus enhancing the interest of the case, these fossils not being such as one would expect to meet in Carboniferous rocks. Large slabs were covered with this *Schizodus*, giving the beds a Permian rather than a Carboniferous aspect. Subsequently, however, *Productus cora*, D'Orb., *P. concinnus*, Sow., and *Sigillaria*, declared its true character. These heaps, though not *in situ*, were very near the parent beds; and were the first of the kind found in such a situation. In the following winter Mr. Davies found in his own garden a drifted block of Millstone-grit containing *Rhynchonella pleurodon* and *Productus cora*; and in March 1860, he and Mr. A. Norris found fossils *in situ* near Treflach Hall, Sweeney. In July of the same year, the writer, together with Messrs. R. Hay and H. Lewis, Oswestry, found *Strephodes*, *Orthides*, &c., in a heap of sandstones lying in a field at Llanforda Isaf, near Oswestry. The same heap yielded a day or two later a more numerous suite of fossils to Messrs. Hay, Lewis, and Davies. During the same year the writer found a *Sigillaria* on Sweeney Mountain; and, in company with Mr. H. Lewis, found also a *Bellerophon* in some fossiliferous sandstone near Oswestry Racecourse.

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* Phillips and Conybeare's Geol. of England and Wales, p. 419.

The fossiliferous strata may be examined on the roadside, and in the fields near Belan Farm and Treflach Hall, Sweeney; as well as in the fine section exhibited in Mr. Savin's sandstone-quarry near the 'Tower.' These beds are, in this locality, of considerable thickness; they occupy the base of the Millstone-grit, and immediately overlie the uppermost layer of the Carboniferous Limestone, which is here of that impure and cherty variety called by the workmen 'Bastard limestone.' These fossiliferous beds have been traced by the writer from Sweeney Mountain on the East, over Cyrn-y-bwch on the West of the Oswestry Coal-field, as well as above Trevor, and the Eglwysegle Rocks. Thus their fossiliferous character is proved to be constant over a distance of nearly twenty miles. Passing in a North-westerly direction, along the margin of the North-Welsh Coal-field, we find the lithological characters of the Sweeney beds shown by the Millstone-grit of Hope Mountain, South of Mold (Sil. Syst. p. 144), of Mynydd Moel, and of Halkin in Flintshire (Yates, Geol. Trans. 2nd Ser., vol. ii. p. 237, &c.); and in all probability these distant localities will prove to be in like manner fossiliferous.

The fossil remains found in these sandstones are in general but indifferently preserved. In the red varieties, perhaps on account of the iron present, they are often little more than casts, the calcareous matter of the Shells having entirely disappeared; but in the cream-coloured sandstones the shells are occasionally seen well preserved.

The writer has found the following organic remains at the above localities:—

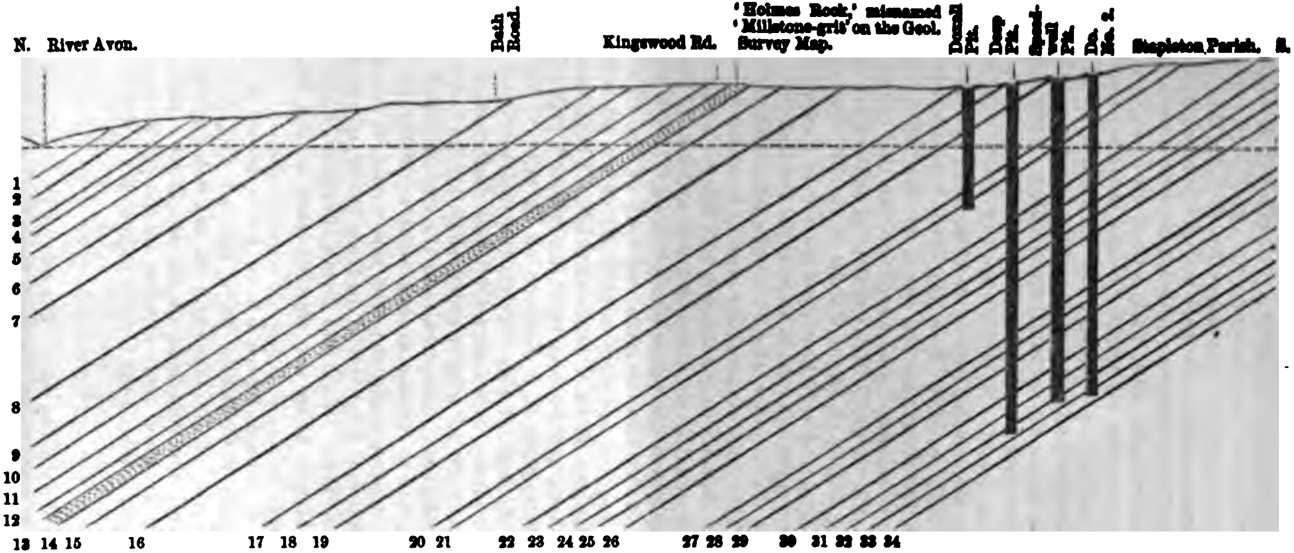
- Sigillaria; Sweeney Mountain; rather rare.
- Strephodes; Sweeney Mountain; rather rare.
- Stems of Encrinites; Llangollen.
- Productus cora; Sweeney Mountain; very plentiful.
- Spirifer; Sweeney Mountain.
- Lingula mytiloides; Sweeney Mountain; rare.
- Rhynchonella pleurodon; Sweeney Mountain; plentiful.
- Orthis resupinata; Llangollen.
- Pecten; Sweeney Mountain; rare.
- Edmondia sulcata; Sweeney Mountain.
- Sanguinolaria (?); Sweeney Mountain; rare.
- Schizodus; Sweeney Mountain; plentiful.
- Pleurotomaria decipiens; Sweeney; rare.
- Bellerophon; very rare.
- Orthoceras giganteum (?); Sweeney; very rare.
- Phillipsia; Sweeney; rare.

Savin's Quarry has yielded a splendid specimen of *Orthoceras*. In length it was four feet six inches; and its diameter at its ends were ten and five inches respectively. There can be little doubt that further search will be rewarded with many additional fossils; but the above is enough to fill up the supposed *hiatus* in the fauna of the Millstone-grit.

V. On the Geological Structure of the District around Kingswood Hill, near Bristol; with especial reference to the supposed Development of Millstone-grit in that Neighbourhood. By Handel Cossham, Esq., F.G.S.

(Read before the British Association, Sept. 1864.)

I HAVE for some years had serious doubts as to the correctness of the Map of the Geological Survey so far as it relates to the supposed presence of Millstone-grit in the northern portion of the Bristol Coal-field in the neighbourhood of Kingswood Hill; and in a foot-note to a most valuable lecture delivered by my friend Mr. Robert Etheridge, F.G.S. (of the Royal School of Mines) at the Bristol Mining School in 1857, and published in a volume of Lectures issued by that Institution, I had, so long ago as that year, expressed doubts as to the existence of Millstone-grit at the surface near Kingswood. Since then I have had much greater opportunities of investigating the matter, having taken, with my partners, a large tract of mineral property in that district; and the results of those investigations thoroughly confirm the doubts I had previously entertained, and in fact fully satisfy my mind that what is shown as Millstone-grit on the Government Geological Map, as also on the valuable map lately published by Mr. William Sanders, F.R.S., of Bristol, is really nothing more than one of the sandstones (the 'Holmes Rock') so common in the Coal-measures proper, and developed on a grand scale in the Pennant-grit dividing the Upper and Lower Coal-



Section of the Coal-measures from the River Avon, across St. George's Parish, to a rivulet in Stapleton Parish. (Distance about 1½ miles.)

LIST OF THE BEDS SHOWN IN THE SECTION.

Coal-seams. No.	Coal-seams. Names.	Thicknesses.	Intervening Shales, &c.
1.	Fig . .	1 ft. 6 in.	2 ft.
2.	Francombe .	1 „ 3 „	150 „
3.	Mill-grit .	4 „ 0 „	90 „
4.	Rag . .	2 „ 0 „	60 „
5.	Devil's . .	5 „ 0 „	108 „
6.	Buff . .	2 „ 0 „	150 „
7.	Parrott .	2 „ 6 „	162 „
8.	Cuckoo .	1 „ 0 „	420 „
9.	Scragg .	2 „ 6 „	240 „
10.	Dolly . .	2 „ 0 „	108 „
11.	Forty Vein .	1 „ 6 „	72 „
12.	Drake . .	2 „ 6 „	96 „
13.	Plock's . .	1 „ 6 „	60 „
14.	Holmes .	1 „ 0 „	48 „
15.	Whitehall .	2 „ 0 „	108 „
16.	Queen's .	4 „ 0 „	240 „
17.	Torn Vein .	1 „ 2 „	360 „
18.	Stump . .	1 „ 5 „	72 „
19.	Black Vein .	1 „ 5 „	66 „
20.	Doxall .	2 „ 9 „	282 „
21.	Five Coals .	2 „ 6 „	30 „
22.	Rock Vein .	1 „ 0 „	174 „
23.	Primrose .	3 „ 0 „	54 „
24.	Lay-along .	1 „ 4 „	24 „
25.	Toad Vein .	3 „ 0 „	30 „
26.	Trow . .	1 „ 1 „	42 „
27.	Pig's Cheek	1 „ 2 „	144 „
28.	Norman's .	1 „ 0 „	54 „
29.	Hard Vein .	1 „ 6 „	30 „
30.	Lr. Five Coals	3 „ 0 „	90 „
31.	Thoroughfare	1 „ 5 „	30 „
32.	Great Vein . .	4 „ 6 „	40 „
33.	Giller's End .	1 „ 10 „	54 „
34.	Little Toad Vein	2 „ 0 „	42 „
Total . . .		71 ft. 4 in.	3,730 ft.

series of all the South-western Coal-fields. I hope it will not be thought presumption in me thus to challenge the opinion of men so much superior to myself in science; but believing, as I do, that it is by the constant development of facts only arrived at by the extension of mining operations in different districts, and by scientific knowledge being brought to bear upon these facts, that perfect accuracy in our geological plans and sections can be attained,—and thinking that it it a duty we owe to ourselves, our country, and to science, to give to the public the full benefit of any new observations we are enabled to make,—I venture to state the ground upon which I have been brought to the conclusion that the Millstone-grit is not present at Kingswood Hill.

1. By a reference to the accompanying section, from the River Avon to Stapleton, which I have had prepared from accurate survey, extending from the Avon, on the south, to the valley that divides the Parishes of St. George and Stapleton, on the north, a distance of 1 mile and 836 yards, I find there is a continuous and almost regular southerly dip, at an angle of from 30° to 40°, although this section crosses the *supposed anticlinal axis* formed by a supposed upheaval of the Millstone-grit. As it is impossible for there to be an upheaval of the grit from under the Coal-measures without an entire displacement of the superincumbent strata, I contend that the fact of there being no such displacement, but, on the contrary, a continuous dip to the south, as shown by my section, is proof positive that no such upheaval has taken place.

2. I further find that the various seams of coal in the district crop to the surface in regular order of succession as we go south from the northern boundary of St. George's Parish. These seams are very numerous; there are no less than thirty-four* cropping out between the points named, in a distance of 1½ miles. They are well-known seams throughout the district, and their position in relation to each other is pretty well ascertained and understood. I find that they always crop out in proper order, showing that, while there may be, and doubtless are, many faults in the district, there is no great displacement, but a regular arrangement of seams all in their proper order and relative position; and this would, of course, be impossible, if the Grit had been forced up from below, as shown on the Geological Survey Map. This fact forms, therefore, another link in the chain of evidence as to the non-existence of the Millstone-grit in this locality.

3. Several branches or tunnels which I have lately driven to the south from the Kingswood Collieries have entered the ground coloured as 'Millstone-grit' on the maps alluded to; but, instead of finding the Grit, we find the coal-beds in regular order; and at present we are actually working coal, dipping to the south, in its proper position, in the place where the Grit is indicated on the map,

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* Exclusive of seams less than a foot thick. The thirty-four seams make an aggregate of 71 ft. 4 inches of coal (see section and list, p. 111).

which, it is quite clear, must be corrected so far as relates to this point.

4. It must not be understood from the remarks I have made that I dispute the existence of an anticlinal axis running nearly east and west across the Kingswood Coal-field. I am quite aware that on the north of my section, in the Parish of Stapleton, there is a clear and well-defined anticlinal axis extending from Bristol, on the West, to Wick Rocks, on the East, and which, in fact, gives the geographical as well as the geological character to Kingswood Hill: but even on the apex of this anticlinal there is no appearance of the Grit; nor is it anywhere brought within at least 400 or 500 yards of the surface. One of the main seams of the district—namely, the 'Great Vein,' marked No. 32 in the annexed list, and shown in my section—has been worked over the whole of Kingswood Hill, at the top of the anticlinal axis, at a depth varying from 30 to 60 fathoms, and from thence northward (at Soundwell) to a depth of 200 fathoms, and southwards (at St. George's) to a similar depth; but between this seam (which is, no doubt, identical with the Bedminster 'Great Vein') and the Millstone-grit, there is proved, at Ashton Vale, to be an interval of over 300 fathoms; so that it is quite evident that the Millstone-grit cannot exist at the surface at Kingswood Hill.

Conclusion.—The band of sandstone called 'Holmes Rock,' belonging to the Lower Coal-measures, and shown on the accompanying section, is what has been hitherto mistaken for the Millstone-grit. The section also shows twenty-one known seams of coal, varying from one to four and a half feet in thickness, lying in regular order below it.

Commercially, then, as well as scientifically, the question as to the presence or absence of the Millstone-grit at Kingswood Hill is highly important; for, instead of the bottom of the Coal-measures, which the Grit itself would mark, we have a considerable extent of valuable Coal-field open to us, which was thought to be barren for the future energy, skill, and enterprise of those to whose talent and perseverance this country is so largely indebted for its past growth and its present prosperity.

ABSTRACTS OF FOREIGN MEMOIRS.

CRETACEOUS ROCKS OF FRANCE AND ENGLAND.

I. ETUDES SUR LE SYNCHRONISME ET LA DÉLIMITATION DES TERRAINS CRÉTACÉS DU SUD-EST DE LA FRANCE, par P. REYNÈS, M.D., &c. 8vo. pp. 116. Paris, 1861.—II. De L'ÉTAGE DANS LA FORMATION CRÉTACÉE. Par le Docteur REYNÈS. 8vo. pp. 16. Marseilles, 1864.

THE Cretaceous strata of the South-east and other parts of France have for some time specially engaged the attention of Geologists; and their differences in petrographic and palæontological characters have been a continual source of controversy. Among the more important workers on this point are D'Archiac, Triger, Sæmann, Renevier, Hébert, Leymerie, Mathéron, Raulin, D'Orbigny, Coquand, and others, all of whom have contributed to the elucidation of the subject, which has also received special attention from Dr. Reynès. His 'Etudes' of 1861 is divided into three parts. The First comprises the history of the different horizons and subdivisions of the Cretaceous rocks, given by different authors; and a résumé of the horizons and their synonymy is offered. The Second Part comprises the succession of these strata in the different districts of France, as shown by local sections (figured also in a lithograph plate), and lists of fossils, for Provence and surrounding Departments, the Maritime Alps, Vaucluse, Dauphiné, Drôme, Isère, High-Alps, Savoy, the Departments of Ardèche, Gard, Hérault, and lastly those of Aude and the Eastern Pyrenees. In the last Part, the order and relationship of the beds are treated of, the synchronism of the separated members of the series is attempted with relation to faunal likeness and stratal position, and some general conclusions are arrived at.

The second memoir (L'Etage, 1864) contains the ripened opinions of the author, modified by further researches in the Chalk of France and England, and also by the study of the labours of others in the Anglo-Parisian basin, Sarthe, Gironde, Charente, and the Mediterranean countries. From these researches the author has prepared the following table, showing the great Cretaceous divisions :—

1. Horizon of *Belemnitella mucronata* and *B. quadrata*, *Micraster coranguinum*, *Hemipneustes radiatus*, &c. 'Chalk of Maestricht and Meudon;' 'Upper Chalk;' 'Dordonian' and 'Campanian,' Coquand; 'Senonian,' D'Orbigny, in part; 'White Chalk' and 'Marly Chalk,' Brongniart, in part.
2. Horizon of *Radiolites fissicostatus*, *Sphærulites sinuatus*, *Micraster brevis*, &c.; beds with *Ostrea auricularis*; beds with *Hippurites Cornuvaccinum*, *Sphærulites augeiodes*, &c. 'Upper Chalk;' 'Marly Chalk,' Brongniart, in part; 'Senonian,' D'Orbigny, in part; 'Turonian,' D'Orbigny, in part; 'Santonian,' 'Coniacian,' 'Provencian,' Coquand; 'Horizon of *Ostrea auricularis*,' Triger; 'Chalk of Villedieu' and 'Hippurite-limestones,' Reynès.
3. Horizon of *Ammonites peramplus*, *Am. papalis*, and *Am. Deveriæ;* beds with *Radiolites cornupastoris.* 'Marly Chalk,' Brongniart, in part; 'Micaceous Chalk of Touraine,' D'Archiac; 'Sands of Uchaux,' Reynès; 'Horizon of *Am. peramplus*,' Triger; 'Mornassian' and 'Angoumian,' Coquand; 'Turonian,' D'Orbigny, in part; 'Lower Chalk.'
4. Horizon of *Inoceramus labiatus; Hemiaster Verneuilli*, *Ammonites Wielbansii.* 'Marly Chalk,' Brongniart, in part; 'Turonian,' D'Orbigny, in part; 'Angoumian,' Coquand, in part; 'Zone of *Rhynchonella Cuvieri*,' Triger.
5. Horizon of *Ostrea Columba*, *O. biauriculata O. carinata*, *Caprina adversa*, &c. 'Beds with *Ostraceæ*,' D'Archiac; 'Lower Chalk;' 'Group with *Ammonites navicularis*,' Triger; 'Carentonian' and 'Gardonian,' Coquand; 'Cenomanian,' D'Orbigny, in part.
6. Horizon of *Turrilites costatus*, *T. tuberculatus*, *Ammonites Rothomagensis*, *Am. inflatus*, &c. 'Glauconitic Chalk,' Brongniart, in part; 'Chalk-marl' and 'Upper Greensand;' 'Cenomanian,' D'Orbigny, in part; 'Rothomagian,' Coquand; 'Chalk of Rouen,' Reynès; 'Group with *Pecten asper*,' Triger.

7. Horizon of *Ammonites lautus, Am. Delucii, Inoceramus concentricus,* &c. 'Gault;' 'Albian,' D'Orbigny; 'Glauconitic Chalk,' Brongniart, in part.
8. Horizon of *Ammonites Cornueli, Plicatula radiola, Ostrea aquila,* &c. 'Plicatula-clay,' Cornuel; 'Speeton Clay,' Phillips; 'Lower Greensand,' and 'Aptian,' D'Orbigny.
9. Horizon of *Chama Ammonia, Pterocera Pelagii.* 'Limestone with *Ch. Ammonia*:' 'Urgonian,' D'Orbigny, in part.
10. Zone with *Ammonites Astieri, Ostrea Couloni, Crioceras Emerici.* 'Lower Greensand;' 'Neocomian,' and 'Urgonian,' D'Orbigny, in part.

As far as the South-east of France is concerned, all but the highest beds (from the Vescomian upwards) are present in Dép. Gard, Ardèche, Bouches-du-Rhone, and Vaucluse.

Believing that the above is a good approximative classification for the Cretaceous beds, Dr. Reynès leaves it for other and experienced Geologists to suggest fit names for the several groups.—J. M.

Mineral Waters considered in their Relations with Chemistry and Geology.

Les Eaux minérales considérées dans leurs Rapports avec la Chimie et la Géologie. Par Henri Lecoq, Professeur à la Faculté des Sciences de Clermont, etc. Paris: J. Rothschild, 1864, pp. 463.

REGARDING all springs as 'mineral waters' that deliver at the earth's surface water that has passed through and become modified by any portion of the earth's crust, Professor Lecoq, in the careful and elaborate work before us, has brought together a great amount of information equally useful to the chemist and the geologist. We shall endeavour to put before the reader a fair abstract of the facts. Of the theories and opinions we shall say but little, only remarking, that they are not in accordance with the views of many English geologists, who will be unwilling to take for granted that the earth has cooled down from a state of igneous fluidity, and will feel surprised at being told (p. 2), that modern lavas come from greater depths than old granite and more recent basalts. They will also demur to the statement, that in former times all rain became mineral water, by immediately sinking into, instead of running for a while over, the earth, and that all existing mineral waters are but the feeble remains of much more powerful springs.

Professor Lecoq traces mineral springs to lines of dislocation, believing that their sources are to be found below the rocks called by him primitive (granite, &c.). He mentions as illustrations, the Geysers and other hot springs of Iceland, the north-south direction of such line of springs in European Turkey, parallel to trachytes and basalts, and the mineral springs of Spain, to the number of four hundred. In France, likewise, out of nearly a thousand such springs, at least eight hundred are traced to a similar origin. Many elsewhere are on the axes of longitudinal valleys, assumed to be due to fracture. Assuming, however, that water exists abundantly in the interior of the earth under pressure, it is not extraordinary that it should come to the surface at weak points, and through fractured portions of strata. We believe also it would not be difficult to find examples where mineral, and even thermal springs, though conducted up to the surface through fissures, do not rise from any great depth, and certainly not from beneath Silurian rock.

The volume of mineral waters poured forth is extremely large. A million of litres (200,000 gallons) a day is no unusual quantity for a single spring. A group of springs in Arkansas, North America, yield more than a thousand litres a minute (2¼ million gallons a day). Of 500 springs rising in the central plateau of France, 231, that have been gauged, yield 12,064 cubic mètres (2,628,000 gallons) every 24 hours. The remaining 269, though smaller, are estimated to add nearly one-fourth (2,810 cubic mètres) to the sum, making a total of nearly 3¼ millions of gallons a day. This is believed to be much below the real total.—(*To be continued.*) —D. T. A.

REVIEWS.

HARMONIC MAXIMS OF SCIENCE AND RELIGION. By the Rev. W. BAKER, M.A., Vicar of Crambe, near York. 8vo. 1864. LONGMAN & Co. London.

NOTES UPON THE ERRORS OF GEOLOGY. ILLUSTRATED BY FACTS OBSERVED IN IRELAND. By JOHN KELLY, V.P. Roy. Geol. Soc. of Ireland. 8vo. 1864. LONGMAN & Co. London.

THE Bible harmonized with Science is not a theme one likes the look of at first sight; we seem to have had enough of it, and more than enough. Not that there is any real reason why the harmonies of the two divine works, 'the Earth and the Word,' should not be studied and admired, but because there are so few—so very few—who can bring the requisite learning to the work. It is not the easy task some think it. That it is an impossible one we strongly doubt; and nothing will so effectually retard it as the ill-considered efforts of good men who are dunces in science,—no, not even the rash denunciations of those who know something of the Earth and but little of the Book. 'We do not know,' says the Bishop of London in his late grand address at Edinburgh, 'how much of our knowledge is purely human and naturally acquired, how much has come down from a supernatural or divine source, even when transmitted by those who professed most vehemently to discard any supernatural help.' We may rest assured in the conviction that no two truths are, or can be opposite; and we may welcome any additions to our real knowledge, while we shut our eyes as much as possible to the clumsy workmanship that tries to fit them together. And having said thus much on the general subject, let us look at the two books before us—so utterly unlike each other. Let Mr. Baker speak first.

The learned author starts with the proposition, that 'certain maxims (the essence of the Inductive Philosophy) must be adopted when we would derive pure or scientific truth from the materials of Nature;' and his aim throughout is to show that these maxims are as necessary to be observed in the study of revealed truth as in the investigation of Natural Science; and that the neglect of them in the study of Revelation prevents our progress in ascertaining the harmony which must exist, as above observed, between all kinds of truth. He lays down the following rules:—

a. Apparent is not identical with scientific truth. *b.* Nature operates by immutable laws. *c.* To ascertain these laws, facts in great variety must be collected, tested, and digested.

All this is unanswerable; and his distinction between the unscientific method which ordinary men pursue to obtain the facts on which they act in daily life, and the scientific order in which philosophers proceed, is justly stated, and applied to the higher purpose. He adopts 'Butler's Analogy of Natural and Revealed Religion;' but asserts that, 'if the method of proceeding with the study of nature be not applicable to the study of revealed truth, that argument wholly breaks down.' We cannot give the list of all his maxims, but must refer the reader to the book itself; while we heartily endorse the first, namely, 'that no truth is injurious;' and the closing one, that 'hindrances to progress must not be allowed.' There are not a few bright thoughts in this remarkable essay; such as, for instance, 'Nature and Revelation are supplementary to each other in the education of Man.' 'The Divine, or that which should be such, ought not to be arrayed against the Divine.' 'All are working for the millennium of peace, good order, and happiness, whether they know it or not.' 'We trace conduct to some governing belief.' 'The tree of knowledge bears not only good, but evil.' 'Laws are the grand treasure, without the knowledge of which science cannot be said even to exist,' &c. And, lastly, that 'right dominant persuasions cannot widely prevail among mankind, while science and religion are antagonistic.'

While we do not at all sympathize with our author in his estimate as to the extent to which this antagonism extends, we cannot but express the belief that his work will do good, and lead a large class of persons who have been in the habit of neglecting either one volume or the other, to see that they are preventing, as far as in them lies, the progress of our race in knowledge, human and divine.

Some of his quotations from Voltaire, and other writers of his class, are extremely pithy; his illustration of some of the miracles equally so; but these would take us beyond our limits. His notes on Man's progress, however, p. 22, are so good, that we must refer to them; and his noble aphorism, that 'it is a condition, in order that a country may make steady advances in scientific knowledge, *that an unfettered Christianity be established in it*,' should win him favour with all classes. His illustrations of the apparent deceptiveness of truth on first impressions, pp. 37–39; of plenary inspiration, p. 44; his references to practical science, p. 60; to the Baconian Philosophy, p. 121,

&c., are admirable, and evince a master-mind. But indeed there is no part of the book which does not deserve perusal. The author means, if another edition is called for, to enlarge the work; and we can offer him no better compliment than to say, that we wait with interest for the second edition.

We wish we could say as much for the next book on our table. We know the author as a geologist of some repute, and long experience; and he has done good service among the rocks of his native country. A better hammer was never wielded; and, if he had persevered in mapping strata and collecting fossils, as he began, and never written a controversial book, it would, we think, have been the better for his fame. We are bound to criticize as well as praise him.

His object in 'Notes upon the Errors of Geology' is stated in the preface. It is 'to show that the approved geological theories of the last forty years, as well as all that went before them, require to be corrected. So far we agree with him. His arguments, he says, convince himself; and, as his 'new theory is a startling one, and nothing (he says) is proposed in it which is impossible,' we ought to gain something by its study. 'It is an unpalatable task,' he remarks truly, 'and perhaps ungracious, to find fault with the speculations, or the visions, or the fancies of anyone.' We should like therefore to avoid doing so, and will endeavour to be as lenient as possible; though, as the author says he expects strong criticism, it might be as well to fulfil his expectation. The purely geological part of the work has some merit, although the preface starts with an error. Half the Devonian fossils are *not* common to the Carboniferous rocks; and Mr. John Kelly ought by this time to know better. The book is to produce a great change in the 'fundamental parts' of Geology; and, if Hutton asserted that 'our planet is built of the ruins of an older world, and that *before it* there were pre-existing continents' (p. 4), we may well wish for some improvement. 'Such imaginary continents,' our author says, 'do not appear to have any facts to support them.' And he has an immense objection to an older world, which must have been made out of an older still, and so on,—like the fleas in the parable. But to be serious, Mr. Kelly must not try to rearrange the whole of the earth's crust. We have systems enough already, and we do not want that on p. 7.

After pitching over Hutton, our author attacks Murchison and Lyell, but is more gracious towards Sedgwick. His observations are so scattered, that it is difficult to follow them; but we think his remarks on the possibility of forming Coal-measures out of the waste of continents, at the present rate of atmospheric action, are very reasonable. So also about the origin of the Old Red Sandstone, which was certainly, to a large extent, volcanic. So, indeed, are many rocks which have been supposed to be chiefly of *aqueous* origin. And Professor Sedgwick's long-reiterated axiom, that the mass of our Palæozoic trap-rocks are lavas *recomposed by marine action*, finds an energetic expositor in the author of this book. His idea extends further, for he would break up these volcanic rocks, granite for instance, by earthquakes, make the divided blocks grind each other into powder, and then puff out this powder by jets of steam from below into the water above. He calls this a 'grinding machine,' and says that 'the best of it all is, that there is nothing in the whole operation either unnatural or improbable.'

In his endeavour to reconcile the apparent differences between Scripture and Geology, the author has our sympathy, but not our approval. It is not needful that we put in print all we think we know; and the dogmatic style upon such recondite questions as have stirred the clearest brains, and tried the strongest hearts, appears to us peculiarly unsuitable. The idea that each genetic day corresponds to one of the great geological periods is not new: it has been for a long while one of the hypotheses which, as Sir H. De la Beche used to say, have served for 'pegs to hang our facts upon.' But hear our author. He gives the first day to his 'Primary System,' now commonly known as the Laurentian epoch. The second day is the 'Cambrian;' the third, the 'Transition,'—an old term, revived by Mr. Kelly, to include the hapless Silurian, with the much-abused Devonian rocks; while the fourth day, when the great lights were made, is, in some unaccountable way, made to correspond to the Carboniferous System and the Coal-measures,—we suppose in anticipation of the use coal would be put to! The fifth is comfortably fitted with the whole Secondary Period, when, according to late discoveries, birds (and reptile-like birds?) flew about upon the earth. The sixth, of course, corresponds to the Tertiary System,—and the whole thing is done.

His remark, that 'there is an omission in the sacred text—no fossils of any kind having been referred to,' is most original (p. 226): see also his summary at p. 222.

The book altogether is excellent reading by the fireside; and as the new views (pp. 51 to 208) take up the mass of the work, the reader is requested to examine them at his leisure. The sketches, maps, and geological illustrations are all remarkably good, for the author is no mean artist, and is, as before said, a practical field-geologist of the hard-working kind. One or two quotations (pp. 188, 189), and we must go to the third part of his treatise. We shall give them without comment.

'The commencement of every system appears to have been characterized by the bursting of the crust of the earth, probably by the agency of steam, accompanied by earthquakes and eruptions of mineral matter. When the new turmoil began, there were new fissures, made in the previously existing rocks; and the sides of a fissure, thirty miles long and thirty miles deep, presented two surfaces, which, when operated on by the expansive power of steam, to lift a block at one side,—by collapse and gravitation to let it down,—and by the friction consequent on this operation, there were produced quartz, jasper, and other hard pebbles enough, from the mineral veins previously existing, for the conglomerates of a new system. The loose materials in such a fissure, after having been ground and polished, were thrown up by puffs of steam, of extraordinary energy; the whole contents of the fissure—pebbles, sand, mud, and all—were thrown out and blown into the waters of the sea to a great height, along with, and in the space occupied by, the steam, where there was no resistance. Immediately when the steam condensed, the contents of the fissure dropped down in the water; pebbles being heaviest, first; next, sand, which filled up the interstices between them ; and lastly, the muddy sediment, deposited as future shale. A second effort to produce sand and mud would probably be in the same fissure; and a third, or perhaps several. In the early efforts, the sides of the fissure, with its fresh fracture, would have produced a large quantity of quartz-pebbles derived from the quartz-veins. After repeated efforts, the sides of the fissure would become worn and smooth, and in the severity of the friction the veins themselves would have been ground to sand. In later efforts, pebbles would get more scarce, and sand and mud more plentiful. In the last discharges from the fissure, probably little or no pebbles, but sand and mud more plentiful for the remaining beds of hard and soft rocks,' &c. &c.

Mr. Kelly's idea is, rightly or wrongly (we think the latter), that 'a mistaken trust in Palæontology has been the cause of many an error' (Preface, p. x.) ; and that the true idea of geological systems should be, that they are 'all clearly separated from each other by unconformable junctions, showing the groups of rocks to be as distinct as the groups of plants or animals' (p. 6). Being best acquainted with the Old Red Sandstone and the Carboniferous rocks, he traces these formations throughout the border-counties of Wales and the whole of Ireland ; his result being, as has been anticipated by some geologists of repute, especially Professor Jukes, that the lower portions of the Old Red Sandstone should be grouped with the Silurian (to form one system, his 'Transition'); and that the upper part, unconformable on the rest, as has been proved long ago by Griffith, Murchison, and the Irish Survey, more lately by Geikie in Scotland, and now by Mr. Kelly himself in the border-counties of Wales, should be grouped with the Carboniferous. We think a little faith in Palæontology a bad thing ; and that fuller light would show him that the distinct character of the fauna, even in this upper member of the Old Red Sandstone, fully entitles us to adhere to the received classification. Fossils are not everything ; but, seeing that we have an unconformity in the midst of the Coal-measures without its much altering the flora and fauna, we may well pause at the threshold of this new theory. Has Mr. Kelly visited Scotland ? We think not. When he does, and we hope he will, he will understand all that has been lately written proving the identity of the Devonian and Old Red Sandstone in all its parts.

We must leave our author, recommending him to stick to the hammer, and yet not lay down the pen. His style is free and humorous, pithy, generally full of force, and of truth too, so far as he knows it. But then there are, we are sure, many lines of geological research on which his clever pencil and ready pen might be employed with profit. We know something of him, and believe that poetry, rather than hard facts, is the legitimate domain in which he is a master. Yet we may be mistaken. He is evidently an earnest student of the Bible, and believes that he can see the way to harmonize what he knows of the Earth with what he believes of the Word. There is that in the latter volume which appeals to the poetic instinct, as well as challenges devout study by the man of science; and we cannot finish this short notice without expressing our real and earnest belief that such studies as our author has attempted will, in abler hands, bring forth much solid fruit. The task, as before said, is not an easy one.

THE QUARTERLY JOURNAL OF SCIENCE. No. V. January, 1865.

BESIDES the usual chronicles of Geology, Palæontology, Mineralogy, and Mining, this Number contains—1st, A second article by Mr. E. Hull, F.G.S., on the History of the British Coal-measures; 2nd, A very interesting, comprehensive, and yet succinct review of the Relations of Geology and Geography to the History of Great Britain, and the causes of her greatness, by Mr. W. Pengelly, F.R.S. 3rd, A chapter on Petroleum, by Dr. H. Draper of New York; and an article on Metal-mining, by Dr. R. Angus Smith, F.R.S.

Mr. HULL here gives an account of the distribution of the *Coal-formation* beneath the more recent strata of the Central and Southern Counties of England, and shows, by a shaded diagram-map, the probable extent of the Scotch, the Central, and the Southern Coal-measures of Britain.

Under the head of 'Nature of the Floor and Original Margin of the Carboniferous Strata,' Mr. Hull says that the Carboniferous beds in South Wales succeed the Devonian in nearly regular sequence, whereas in the North of England and Wales, owing to disturbance and denudation, the floor of the Coal-measures is for the most part, if not altogether, Cambro-Silurian beds. From the outcrop of Cambrian rocks in Leicestershire, and by tracing the boundaries of the Coal-fields of the Midland Counties through Warwickshire, S. Staffordshire, Worcestershire, and Shropshire, into North Wales, frequent evidences of the proximity, or actual appearance, of a ridge or barrier of land, which formed the margin of the Carboniferous area, across the centre of England, may be found. Mr. Hull is of opinion that the Coal-measures originally formed two separate areas, one lying to the north, the other to the south of the 'Barrier;' these two areas having subsequently been broken up into separate 'Coal-fields,' which may be thus arranged:—*North of the Barrier*—North Wales, Forest of Wyre, North and South Staffordshire, Warwickshire, Leicestershire, Derbyshire, and Yorkshire, Northumberland, Durham, and Cumberland; the Coal-fields of the central valley of Scotland having been probably connected with these round the East coast. *South of the Barrier*—South Wales, Somersetshire, and supposed band along the Thames Valley.

By tables of thicknesses of the Carboniferous series North of the Barrier it is shown that the greatest mass is attained in Lancashire (12,800 feet), decreasing in North Staffordshire (8,800 feet), and less than one-fourth in Leicestershire (3,100 feet). South of this elevated tract, in Glamorganshire, the thickness is 11,980 feet, whilst in the Forest of Dean, in Gloucestershire, it is only 3,210 feet.

might expect to find illustrations of the theory of the "Evolution of species by the gradual alteration of existing forms." I do not think, however, that the evidence yielded by these deposits is, on the whole, favourable to that theory; for if I read it aright it is something like this: In the lowest beds we find a certain number of species of various Orders, *Radiata*, *Echinodermata*, *Crustacea*, and *Mollusca*. Each species seems to have its central typical form, with varieties diverging on either side until they approach the like divergent varieties of other species. Thus, on an horizontal line representing SPACE, we have species with central forms, very distinct, but united by divergent varieties; and then, ascending upwards through strata representing TIME, we meet with the same central types and the like variations surviving through an immense period of time, and all the many changes of condition referred to. New species are added in the upper beds; but we do not meet with that gradual *vertical* divergence from the old types to the new which would certainly be the case if such new species were but the modified descendants of the older forms. And if we contrast the species which appear for the first time in the middle or upper bands of limestone with those characteristic of the old, suppose we take *Orthis* and *Leptæna* among the *Brachiopoda*, or Corals among the Zoophytes, we shall perceive how great the divergence is; and we look in vain for those transitional forms which, supposing the theory to be true, we ought certainly to find in the intervening strata.'

Mr. H. DUCKWORTH gives a note *On the San Ciro Cave, near Palermo.* A section of the strata at Thatto Heath, near Rainhill, by Mr. G. H. MORTON, is referred to, by which he showed 'the certainty of productive beds of coal being beneath the Trias, and that they were cut off by the great fault which throws up the Coal-measures.' Lastly, Mr. T. J. MOORE mentions the chief fossils in the *Derby Museum of Liverpool.*

THE TRANSACTIONS OF THE NOVA-SCOTIAN INSTITUTE OF NATURAL SCIENCE OF HALIFAX, NOVA SCOTIA, Vol. II. Part 1, 1864.

CAPTAIN C. HARDY gives an account of the Caplin or Capelan (*Mallotus villosus*), which represents perhaps the only species of fish found both fossil and recent, unless some of the ear-bones (Otolites) from the Post-tertiary and Tertiary Strata prove good witnesses of still-existing species, when Mr. E. Higgins' researches shall have been completed. In the GEOL. MAG., No. II., Dr. SARS described the Norwegian nodules containing Caplins. Prof. HOW describes the *Mineral Springs of Wilmot, N. S.*, marked by the presence of sulphate of lime, like some springs of other parts of Nova Scotia that are known to traverse Gypsiferous rocks. Mr. GOSSIP presents some notes on the *Slate and Granite District near Halifax*; noticing, among other things, that though a hard gneissose quartzite, good for flagging, can be quarried close by, Halifax sends to Caithness for pavement-stones. The granite at Halifax seems to present two varieties, coarse- and fine-grained, in close proximity, as in many other parts of the world (as noticed by Dr. BIGSBY, GEOL. MAG., No. IV. p. 158). Probably the structure of this slate and granite country would be better understood if looked at with an eye to great crumplings, pressure, and metamorphism, rather than to the presumed eruptive condition of the granite. Prof. How's *Notes on the Economic Mineralogy of Nova Scotia*, Part I., relate to some hæmatitic and titaniferous iron-ores. The results of the two visits of Exploration made by some of the Members of the Institute to the Kitchen-middens at St. Margaret's Bay and Cole Harbour form an Appendix to the Institute's Transactions, Part I.

OUTLINES OF THE GEOLOGY OF THE BRITISH ISLES, TO ACCOMPANY THE GEOLOGICAL MAP. By ARCHIBALD GEIKIE, F.R.S.E., F.G.S. 8vo. 1864. Edinburgh: JOHNSTONE.

THIS handbook, explaining a Geological Map of the British Isles, briefly describes the various strata, and their arrangement under different forms of ground, and has three divisions; namely, 1st, under 'England' (which ought to be 'England and Wales'); 2nd, 'Scotland;' and, 3rd, 'Ireland;'—a very fit arrangement, because, though some of the rocks and strata are necessarily treated of over again, yet their local differences are thus specially noticed, and their relations shown. An introductory portion gives a general résumé and table of our sedimentary strata, with brief remarks on igneous and metamorphic rocks. The body of the work consists of a carefully condensed account of the different Geological Groups in the three Kingdoms, with short notices of the several contemporaneous volcanic rocks. We miss, however, some notice of the Rhætic group—well represented as it is at Exmouth in England, Penarth in South Wales, Linksfield in Scotland, and Lisnagrib in Ireland.

Ten well-chosen illustrative diagrams are given as woodcuts; and the five sections engraved on the map are well described in the later pages of the book, as showing the relations that the different stratal series bear to each other in bold stretches across different parts of the British Isles. Limited groups of Fossils, characteristic of the different Systems, and selected from published works, are also engraved on the Map; and notes of local peculiarities are frequent at the margin of the land. The Map is colour-printed with heavy tints.

OLD BONES; OR, NOTES FOR YOUNG NATURALISTS, ON VERTEBRATE ANIMALS, THEIR FOSSIL PREDECESSORS AND ALLIES. By the Rev. W. S. SYMONDS, F.G.S., &c. 2nd Edit., 8vo. London: HARDWICKE. 1864.

WE are glad to see that the Second Edition of this work has been called for by the Public, and that the Author having made many additions and improvements, the Publisher still issues it at a low price, so that it can be widely spread among students both of Palæontology and Zoology. This little handbook has five chapters, four of which consist of well-selected and usefully arranged notices of the characters, habits, and structure of the chief kinds of Mammals, Birds, Reptiles, and Fishes, and the distribution of the fossil species representing them in Geological Time. The fifth chapter, new to this edition, and drawn up with the assistance of Dr. Lankester, treats of the structure and composition of tooth and bone, showing the distinctive features of bones in different animals.

Based on the 'Vertebrate' portion of Owen's 'Palæontology,' illustrated by notes from the works of many travellers and observers, and referring, for living, preserved, and fossil specimens, to the Zoological Gardens and British Museum, 'Old Bones' may be recommended as a good introduction to the study of Vertebrate Life, past and present. The student will find the Geological range of the fossil species fairly indicated. We may notice, in particular, that the first chapter has been enriched with facts respecting the Antiquity of Man, and his co-existence with extinct mammalia, evidence of which is supported by the researches and publications of Boucher de Perthes, Prestwich, Falconer, Lyell, and others.

REPORTS AND PROCEEDINGS.

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Geological Society of London.—I. January 25, 1865.—W. J. Hamilton, Esq., President, in the Chair. The following communications were read:—

1. 'Notes on the Climate of the Pleistocene Epoch of New Zealand.' By Julius Haast, Ph.D., F.G.S.—The main feature in this communication was a notice of the occurrence of bones of the *Dinornis* in the moraines of the extinct glaciers of New Zealand. In support of the author's opinion that the extinction of that bird was due to the agency of man at a somewhat recent date, it was observed that the present Alpine flora furnished a large quantity of nutritious food quite capable of sustaining the life even of so large a creature; and as the fruits of these plants were at present applied to no apparent purpose in the economy of nature, the author argued the former existence of an adequate amount of animal life to prevent an excessive development of vegetation. This part, he considered, was played by the *Dinornis.*

2. 'On the Order of Succession in the Drift-beds in the Island of Arran.' By James Bryce, M.A., LL.D., F.G.S.—In a paper read last year before the Royal Society of Edinburgh, the Rev. R. B. Watson described all these beds as Boulder-clay, and did not assign the Shells which he had discovered in them to any particular part of the deposit. Dr. Bryce dissented from this view, and in this paper pointed out the various causes of error likely to mislead an observer in examining such accumulations. He then described the various sections of the deposits, and showed that the lowest bed is a hard, tough, unstratified clay, full of striated, smoothed,

and polished stones of all sizes, but totally devoid of fossils, and that it is, in fact, the true old Boulder-clay of the geologists of the West of Scotland. The Shells are entirely confined to a bed of clay of open texture, containing a few small stones; it rests immediately on the Boulder-clay, as above defined, and is succeeded by various drift-beds, consisting of seams of clay and sand intermingled, containing stones that are rarely striated, and without Shells. Dr. Bryce then discussed the probable origin of these drifts, and the amount of depression which the land had sustained before the Shell-bed was deposited over the Boulder-clay, which he considered to have been formed by land-ice emanating from central snow-fields, and covering the whole surface of the country.

3. 'On the Occurrence of Beds in the West of Scotland in the position of the English Crag.' By James Bryce, M.A., LL.D., F.G.S.—In consequence of the results arrived at from the investigation of the Drift-beds of Arran, Dr. Bryce determined to examine all the recorded cases of fossils occurring in the Boulder-clay, the Chapel Hall case having, however, been already undertaken by the Rev. H. W. Crosskey. The most celebrated case is that of the occurrence of Elephant-remains at Kilmaurs, near Kilmarnock, in Ayrshire; and the author showed, from a section of the quarry exposed for the purpose by Mr. Turner, of Dean Castle, which corresponded exactly with one already furnished to him by an aged quarryman, that the Elephant-remains, the Reindeer's horn, and the Shells, all occurred in beds below the Boulder-clay, and not in that deposit, as has always been stated. The same conclusion was arrived at respecting the occurrence of Elephant-remains at Airdrie and Bishopbriggs, and of Reindeer's horn with Shells at Croftamie; and the author concluded by discussing the question whether the fossils belong to the Upper Crag period, or merely indicate a downward extension of the Arctic fauna which characterises the beds directly above the Boulder-clay, as described in the last paper.

4 'On the *Tellina proxima* Bed at Chapel Hall, near Airdrie.' By the Rev. H. W. Crosskey. Communicated by Dr. Bryce, F.G.S.—One of the most perplexing cases in Scotland, upon any theory of the formation of Boulder-clay, has been the alleged occurrence at Chapel Hall of a clay-bed containing *Tellina proxima*, intercalated between two masses of true Boulder-clay. The Shells were first found by Mr. James Russell in sinking a well; and the case was made known by Mr. Smith, of Jordan Hill, in a paper laid before the Geological Society in 1850. At the author's request, Mr. Russell had sunk another well seven yards from the former, from an examination of which Mr. Crosskey satisfied himself that the bed above that containing the Shells is not the true Boulder-clay, but an Upper Drift, and that the Shells occurred in a hollow of the lower clay, or true Till, filled up with a clay-deposit of an age intermediate between that of the other two. He therefore considers that this can no longer be regarded as one of fossils occurring in the true Boulder-clay.

II. February 8, 1865.—W. J. Hamilton, Esq., President, in the Chair. The following communications were read:—

1. 'On the Sources of the Mammalian Fossils of the Red Crag, and on the Discovery of a new Mammal in that Deposit, allied to the Walrus.' By E. Ray Lankester, Esq. Communicated by Prof. T. H. Huxley, F.R.S., F.G.S.—The Mammalian fossils of the Red Crag were stated to belong to three groups:—(1) the teeth of *Coryphodon*, &c., derived from lower Eocene strata; (2) the other terrestrial Mammalia; and (3) the Cetaceans. The *Molluscan* fauna of the Red Crag was cited in proof of its identity in age with the Upper or Yellow Crag of Antwerp, which contained none of the Red Crag Mammals. The underlying Middle and Black Sands of Antwerp contain far larger percentages of extinct forms and very abundant Cetacean remains. The deposits at Darmstadt and in the South of France, containing terrestrial Mammalia similar to those of the Red Crag, are also anterior to the Yellow Crag of Antwerp. The Red Crag was thus shown to include Mammalian fossils found nowhere else excepting in strata of an earlier age. The probabilities therefore were that these various Mammalia were not indigenous to the Red Crag, but were derived from the breaking up of earlier strata; and this supposition was supported by lithological evidence which the author gave in detail; he also discussed the chemical and mineralogical questions involved. Further evidence of the extraneous nature of the Mammalian fossils was also adduced, in the fact that teeth of *Rhinoceros* and *Mastodon* occurred at the base of the Coralline Crag; and other less conclusive facts were cited. The great abundance and perfect condition of teeth of *Carcharodon* and Ziphioid Cetaceans in the Middle Crag of Antwerp, their absence in the Yellow Crag of that locality, and their presence, in a much rolled, indurated, and fragmentary condition, in the Red Crag, often with portions of their previous sandy matrix adhering, was considered as conclusive evidence with regard to the Cetacean remains. Mr. Lankester then described the tusks of an animal allied to the Walrus, but probably much larger, which he proposed to call *Trichecodon Huxleyi.* The minute details of form and structure were entered into, and the author stated that the teeth called *Balænodon* by Professor Owen belonged really to two genera, *Ziphius* and *Squalodon*, as shown by the remains from the Middle Antwerp beds.

2. 'Note on the Geology of Harrogate.' By Professor John Phillips, M.A., F.R.S., F.G.S.—The cuttings on the North-eastern Railway, combined with sections exposed in several quarries, have enabled the author to trace the range of the Millstone-grit, Calcareous roadstone, and Yoredale Shales near Harrogate; and have also thrown some light on the relation of the Permian to the more ancient rocks. Prof. Phillips was also enabled to refer the mineral springs, with greater confidence than heretofore, to a deep source along an axis of movement; and to suggest that the Harrogate roadstone probably corresponds to the 'main' or '12-fathom-limestone' at the top of the Yoredale series. These results, the argu-

ments and facts in support of them, and the inferences obtainable from their consideration, were given by the author in this paper, which was illustrated by a horizontal section from Wharfe, on the S.E., through Harrogate, to Nid on the N.W.

ROYAL GEOLOGICAL SOCIETY OF IRELAND.—I. January 11, the Rev. Dr. Lloyd in the chair. The Secretary read Dr. L. LINDSAY'S paper on *the Geology of the Gold-fields of New Zealand.* That of Tuapeka in Otago has the gold in quartz-veins and in gravel, as usual: the latter alone yielded, up to Sept. 1864, gold valued at about £6,000,000. The Auckland or Coromandel Gold-field, described by Heaphy, Hochstetter, and Hector, consists also of auriferous quartz-veins and gravel, but has not been fully worked.—Mr. GILBERT SANDERS offered some remarks on the gold-valleys of Wicklow, especially on their close geological similarity to those of New Zealand. The drift-gold, however, of which there is plenty, had not yet been clearly traced to any one of the quartz-veins in the Croghankinshela Mountain, neither by the Carysfoot Mining Company, nor when Government formerly worked the district. Magnetic iron occurs also in Wicklow, as at Auckland and elsewhere, with the gold-rocks.—Messrs. Scott, Baily, and Boswell also joined in the discussion; and Dr. Haughton (who took the chair when Dr. Lloyd left), in his closing observations, stated that Croghankinshela, on the flanks of which are the gold-streams, is a granite mountain of an extraordinary diversity of composition.

II. The Annual Meeting was held on February 13, the Rev. Dr. Haughton in the chair. After the election of President, Officers, and new Fellows, the Secretary read the Annual Report, congratulating the Society on its improved position under its new name, and giving an obituary notice of the late and highly respected General Portlock, whose name is intimately connected with the progress of Geological Science, and with the Geology of Ireland in particular. Dr. J. K. Baillie and Mr. G. Blackwood were also noticed as lost to the Society by death. A valuable résumé of the papers read before the Society, and a favourable financial statement, completed the report. The Chairman also congratulated the Society on its well-being and good influence; on the communications it had received during the year; and on the high scientific standing and fitness of its new *President*, the Earl of Enniskillen, F.R.S., &c. The *Vice-Presidents* are, Sir R. Griffith, Bart., W. J. Kelly, Esq., Dr. A. Carter, W. Andrews, Esq., and Rev. Dr. Lloyd: *Treasurers*, G. Sanders, Esq., and Dr. F. J. Sidney: *Secretaries*, R. H. Scott, Esq., and R. S. Reeves, Esq.

EDINBURGH GEOLOGICAL SOCIETY.—January 26th, Mr. C. Maclaren, F.G.S., President, in the chair. Mr. A. MATHESON, Jedburgh, one of the Associates, gave an interesting description of 'The Fossil Plants in the Bed of the Tweed.' He exhibited polished sections of these fossil plants from the Mountain-limestone, about from 200 to 300 feet above its junction with the Old Red Sandstone at Tweedmill and Norham Bridge. Mr. Matheson also described the 'Kames' on the Greenlaw Moor and the Dogdon Moss, and the mechanical laws which formed them, giving it as his opinion that lakes formerly existed in these places, and that these lakes were afterwards drained. Mr. J. P. FALKNER, S.S.C., read his 'Notes of Two Journeys in 1864 across the Cairngorm Hills.'—*Caledonian Mercury*, Friday, Jan. 27, 1865.

GLASGOW GEOLOGICAL SOCIETY.—January 19th, Rev. H. W. Crosskey in the chair. Professor A. Winchell was elected a corresponding member. Mr. J. YOUNG exhibited and described a fine series of teeth of *Rhizodus Hibberti* from the Black-band Ironstone of Possil, near Glasgow, which is in the upper portion of the Carboniferous Limestone series, and 524 fathoms below the 'Upper Coal' of Lanarkshire. Prepared sections illustrated the structure of these teeth. Some of them are 4½ inches long by 1½ in breadth, above the jaw-bone. They are also found separate, as if broken from the jaw. Nearly perfect remains of smaller fishes are found with them.

Mr. J. THOMSON exhibited a slab of Carboniferous shale, from Stonehouse, containing several bones of the head, with upwards of 100 teeth, of *Diplodus gibbosus*, regarded by Agassiz as one of the flat cartilaginous fishes, such as the Sting-ray. *Pleuracanthus lævissimus* is, according to Sir P. Egerton, the barbed fin-spine of this species.

An excellent model-section of the Black Prince Pit, at Shettleston, made by Mr. J. STOKES, was exhibited and described by Mr. J. Young. The section is made up of the finely pounded material of the various strata passed through in sinking the pit to the 'Virgin' or 'Sour-milk Coal,' compressed in consecutive order into a narrow box, about 7 feet in length, with a glass front, and displaying distinctly not only the order of superposition and respective thickness of each bed, but also the colours of the various beds. Mr. Young explained the several parts of the section, and pointed out the position of the various coals which lie between the 'Upper Coal' of the Lanarkshire basin and the 'Virgin Coal.' In reference to the colours of the various sandstones, shales, and seams of coal which were represented in the section, producing an extremely variegated column, beautiful in its variously tinted stratification, Mr. Young remarked that few persons unacquainted with the subject would readily believe that such a variety of rocks and colouring were to be met with in sinking an ordinary coal-pit; while by those who had studied the subject, and were convinced that each of these many coal-seams represented an ancient land-surface, on which was accumulated, from the growth of vegetable matter, those deposits now forming our coal-beds, and that the sandstones represented long periods of submergence, while the material forming them was being slowly deposited in sea, estuary, or lake—no doubt could be felt as to the immense time required for, and the great antiquity of, their formation.

Mr. Skipsey shortly explained the relation of the coal-beds represented in the section to the 'Ell' and other well-known seams in the neighbourhood.

Mr. J. Reid read a paper *On Continuous Internal, Vertical, and Horizontal Movements in the Earth's Crust*, referring to cracks, joints, 'slickensides,' 'lypes,' and 'lunkers' in the Coal-measures as evidence; and regarding the 'underclays' as being material of contiguous beds ground down by pressure. The 'waves without wind' in Lochs Lomond and Tay, the apparently causeless tremulousness of water and leaves, cracking of walls, shrinking of lintels in houses, the giving way of embankments, &c., were also referred to as being often the results of internal movements of the earth's crust.

Mr. R. Skipsey read a paper *On some of the Trap-rocks and Minerals of the Cathkin Hills*, of igneous origin, ranging east and west a little south from Rutherglen. The quarries opened about the middle of the range exhibit many varieties of igneous rock, and the minerals usually accompanying such. These consist of columnar and amorphous basalt, several varieties of greenstone and porphyries. Among the minerals are heliotrope or green jasper, amethyst, rock-crystal, calcareous spar, and deep-green talcose chlorite. Several varieties of the rocks are very fine, the columnar basalt especially, being a mass of beautiful columns at present laid open to a depth of 30 feet, but going downwards about 30 more. They are as perfect in form as those of Staffa and the Giant's Causeway, and are from two to three feet diameter, the prisms being four- and five-sided, and in several other parts of the hills the form is equally perfect. The tops of the columns exhibit a fine illustration of the effects of the Boulder-drift, the groovings of which are remarkably regular.

It is a matter of deep regret to geologists and admirers of natural scenery to see these fine monuments of antiquity destroyed, even for the useful purpose of keeping the roads in repair, and it would be no great sacrifice to the proprietor to leave some portion of these majestic columns of basalt standing.

Mr. John Dennison exhibited a vertical section, 16 feet long, of all the various geological formations, with a centre column of coloured drawings of fossil organisms; showing at a glance the order, composition, the minerals, metallic ores, and characteristic fossils of each formation. This section, drawn by Mr. A. Dennison, Edinburgh, was much admired for the artistic excellence of its execution and design.

Norwich Geological Society; in connection with the Norfolk and Norwich Museum.—On January 3rd the usual monthly meeting was held, the Rev. John Gunn, F.G.S., President, in the chair. The discussion on the specific differences between *Trogontherium Cuvieri*, the Beaver of the Cambridgeshire Fens, and the recent Beaver, was resumed by Mr. Harper. Some fine remains of the Beaver from the Fens, and a magnificent tusk of *Trogontherium* from the Norwich Crag, were produced by Mr. Robert Fitch, F.G.S. Mr. Harper observed that there was a decrease in the size of the tusks from the *Trogontherium* to the Fen specimens, and equally so from the Fen specimens to the recent. A question was raised as to whether *Castor Europæus* had ever been obtained from the Forest-bed. The smaller specimens might probably belong to younger and not full-grown *Trogontheria.* The greater proportionate size of the posterior molar tooth in the lower jaw of *Trogontherium* was pointed out by Mr. Gunn as a mark of difference from *Castor Europæus.* It is remarkable that in the Bacton specimen (a cast of which was presented to the Norwich Museum by the Rev. S. W. King., F.G.S., of Saxlingham Rectory), and in every other already described specimen, this tooth is missing. It is less firmly fixed in the jaw than the other molars; and in Mr. Gunn's specimen it had been loose and had dropped out since it had come into his possession. This may be regarded as a satisfactory proof of the correct view of Professor Owen with respect to the difference between *Trogontherium* and *Castor Europæus*; and M. Lartet is not correct in stating, in a note to 'Cavernes du Périgord' (page 21), that Palæontologists have not made any distinction between the two. The attention of the members of the Society was specially directed to the collecting of these interesting remains.

A paper was then read by Mr. A. W. Morant, F.G.S., on the *Formation of Flint in Chalk.* He had, in the first instance, compiled, for his own information, all that had been written by the best authorities on the subject, and it had occurred to him that the compilation might be useful and acceptable to the members of the Society (as it certainly was). The subject is one of great interest, and was well discussed. As an illustration of the theory of segregation of the siliceous particles from the calcareous mud, Mr. Bayfield stated that in the manufacture of pottery, where the pounded calcined flints are mixed with pipe-clay into a plastic mass, if the latter be allowed to stand a few days, the silica will be aggregated into nodules. Mr. Braidman stated that under a temperature exhibiting a pressure of sixty pounds, in an alkaline solution, flint became perfectly soluble. Mr. Taylor showed that the silica dissolved in sea-water, therefore, is the storehouse whence the Diatomaceæ obtain their supply, whilst their shields, accumulating on the ocean-bottom, would form nodules and bands as in the case of the Chalk-formation.—J. T. & T. G. B.

BRISTOL NATURALISTS' SOCIETY.—I. December 7th, 1864.—At the Thirty-second Ordinary Monthly Meeting, Mr. W. Sanders, President, in the chair, the Secretary announced the election of eight new members, and brought forward a resolution of the Council relative to the formation of a Scientific Library by Voluntary Subscription. Mr. D. DAVIS read a paper *On the Natural History of the Inhabitants of the British Isles.*

II. *Geological Section,* Nov. 25th —Mr. W. Sanders in the chair. It was resolved that the day of meeting be altered from the fourth Friday to the fourth Thursday in the month. An indiscriminate series of fossils from rocks below the Devonian were placed upon the table for examination, and the President proposed that each evening should be devoted to the study of one special class of fossils, so that ultimately the members might become familiar with many, if not all, of the extinct remains, and therefore he, in conjunction with Mr. Stoddart, exhibited, as a commencement, examples of the oldest known forms of animal life, indicating their locality in this neighbourhood. Thus, at Tortworth all the characteristic Lower Silurian fossils, as found in Wales, might be obtained; and there also, as well as at a point between Longhope and Grange Court Stations, on the South Wales Railway, a large number, if not all, of the Upper Silurian corals were to be found. A slab of stone from the Wren's Nest, Dudley, was thus shown, containing a great number and variety of Wenlock limestone (Upper Silurian) fossils, among which we may name *Cœnites labrosus*, *Alveolites repens*, *Atrypa reticulata*, *Retzia cuneata*, *R. deflexa*, *Fenestella asimilis*, and *Rhynchonella borealis*. After some discussion upon these, Mr. Stoddart exhibited a perfect specimen of *Calymene Blumenbachii*, found at Martley, Worcestershire; also *Nummulina lævigata*, and *Alveolina Boscii*, which he had obtained in the Eocene beds of Sussex; and, lastly, *Fusulina cylindrica*, from the Russian Carboniferous Limestone.

III. At the Monthly Meeting, January 12th, Mr. W. Sanders in the chair, Mr. HANDEL COSSHAM read a paper *On the Pennant Formation of the Bristol Coal-field*. The term 'Pennant' was applied to a well-defined band of sandstone occurring between the Upper and Lower Coal-measures, varying very much in colour—dark-brown, reddish, and grey—but easily worked for paving and other purposes, and remarkable for the quantity of water it contains, which rendered the working of coal in or under the Pennant more difficult than above it. The Coal-measures might be roughly divided into three series:—1, the coal itself, of which there were 50 seams at Radstock, with an aggregate thickness of 90 feet; 2, the coal-shales, argillaceous strata, which contained the most delicate fossils; and, 3, sandstones, of which the Pennant was one, specially defined, and below which they were not so numerous, thick, or coarse as above it. The author then stated his belief that the Bristol, South-Wales, and Forest of Dean Coal-fields had in former times been part of one and the same, and he showed that the coal itself might be divided into five series—Radstock and Faringdon Gurney, under which came the Pennant; and then the Kingswood, Bedminster, and Ashton series, lying upon the Millstone-grit, which embraced the whole. With the aid of a map, Mr. Cossham traced the course of the Pennant round the Coalpit-heath field, and pointed out how entirely its dip was everywhere conformable with the dip of the coal-strata, and that, with a slight exception, the circuit was complete at the surface of the ground; while in the Somersetshire coal-field the Coal-measures were covered by Oolite, Lias, and New Red Sandstone; and the Pennant only appeared at the surface in two places, owing to upheavals. Near Kingswood a great upheaval had taken place, due east and west, and the Pennant had even been denuded: it appeared again, however, at Crew's Hole, and dipped the New Red Sandstone plain of Cheshire to those of North Wales. But more than that, I take it that the patch of Carboniferous Limestone near Corwen, together with the Flintshire escarpments, makes it almost certain that the whole Carboniferous formation spread formerly over the greater part of North Wales, with just a few island-peaks of older rocks, perhaps, rising up through it. In short, I believe that, with the possible exception of a few isolated points there and elsewhere, as in Cumberland and about the Southern Highlands of Scotland, the whole of the Southern half of Scotland and all England and Wales were, at the close of the Carboniferous period, covered by level and continuous sheets of Coal-measures.

Local thinnings and thickening of the beds there were, doubtless, in all directions.

As to Ireland, I have long taught in my lectures, and I believe demonstrated, that, with the exception of a few small isolated peaks of the Older Palæozoic rocks, it also was at the same period one great plain of Coal-measures, whether above or under water.

How far the Carboniferous Limestone of the Isle of Man proves that the English and Irish Carboniferous formations were then connected across what is now the Irish Sea, I forbear to decide. My own private opinion is that they were more or less connected, just as at a later period the Red Marls and Lias of Antrim were continuous with those of Cheshire, Worcestershire, and Gloucester.

I almost fear that I am writing what to many persons will appear mere common-place truisms; but the expressions of your Reviewer have induced me to run the risk of that imputation rather than that any persons should retain what I believe to be erroneous and narrow views in our science.

The portions of the Palæozoic rocks still left in our islands are only the mere ruined fragments and foundations of those that once existed. The hole in the Chalk that occurs in the Wealden district excites attention because, from its comparatively slight extent, people can see that it is a hole, while the far more extensive destruction of the older rocks has been so great that the former continuity of their fragments is ignored or discredited.—Yours, &c.,

J. BEETE JUKES.

DUBLIN: *Feb.* 6, 1865.

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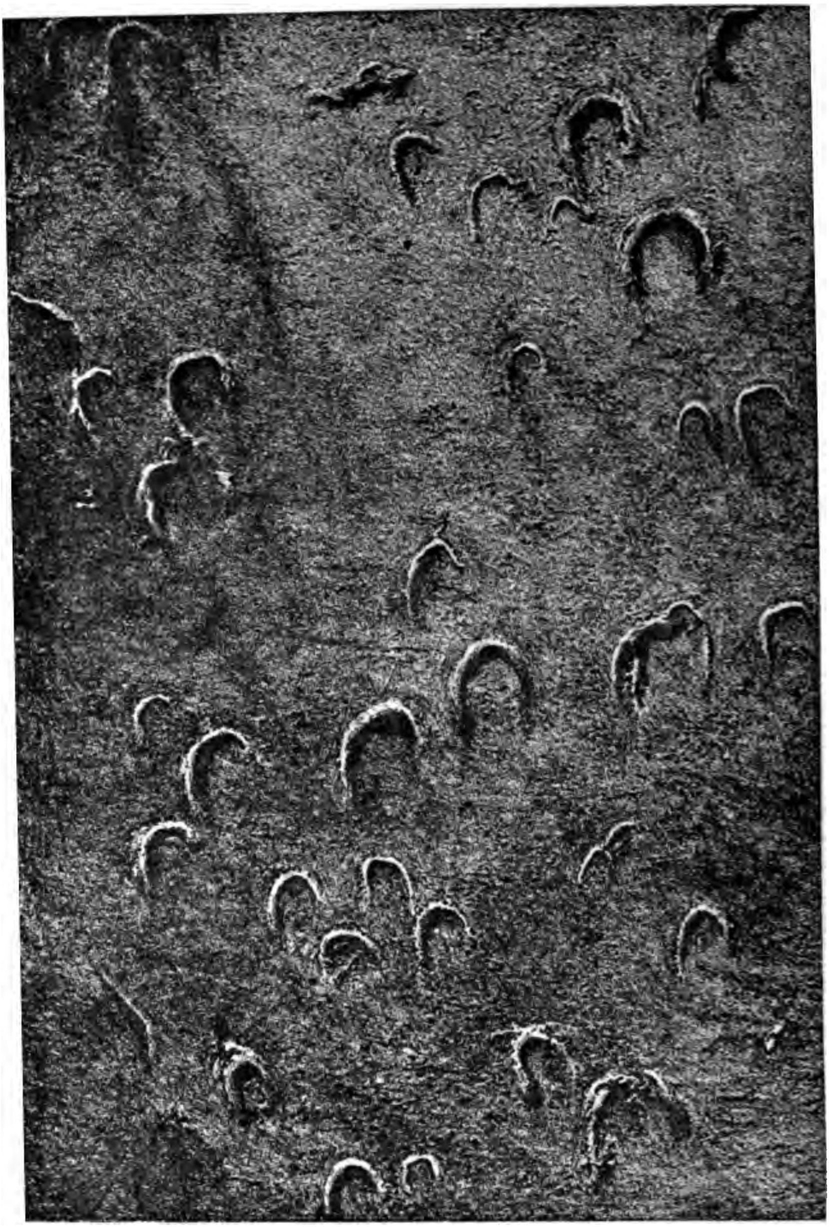
2. CARBONIFEROUS SANDSTONE WITH SURFACE-MARKS.

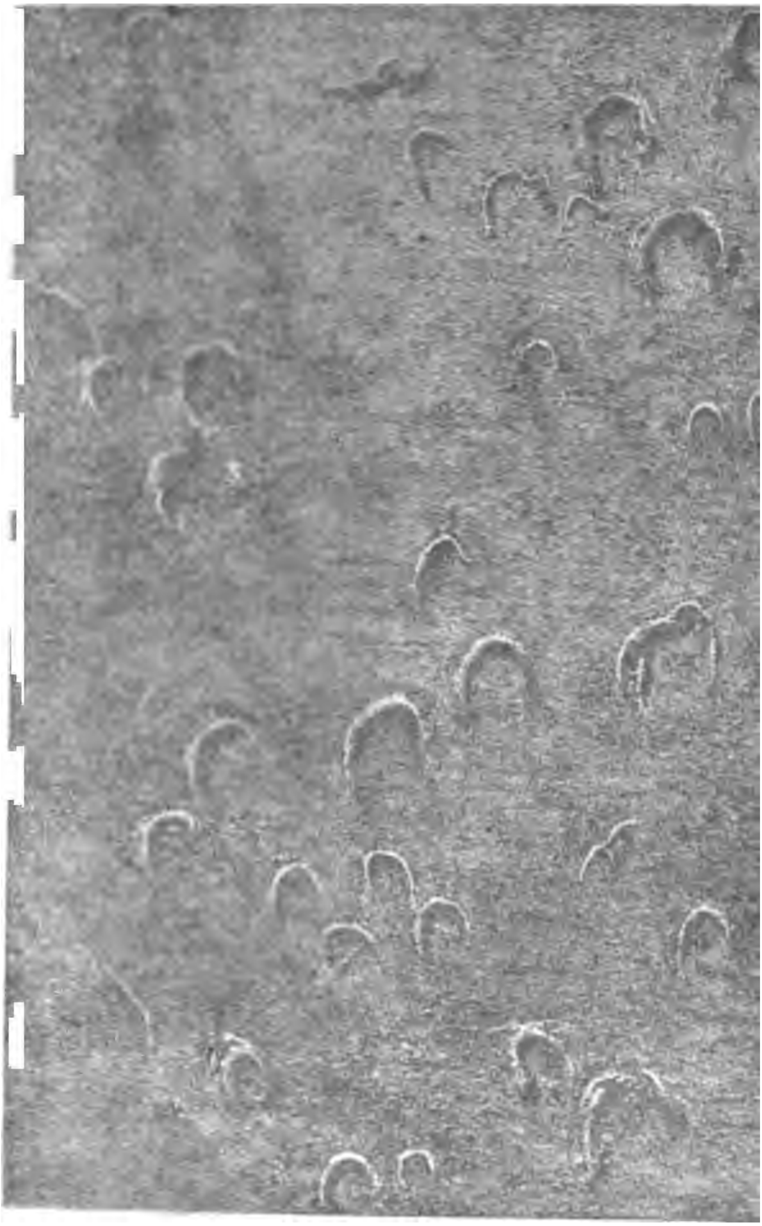
[Plate IV.]

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—Having lately obtained a slab of one of the Carboniferous sandstones (a few feet below the 'Yard-seam' and above the 'Five-quarter-seam' at Bowden-close, in the Bishop-Auckland Coal-field, Co. Durham), which bears about fifty impressed hoof-shaped marks, and not being aware that any such markings, usually supposed to be foot-prints of some animal, have been found lower down than the



MARKINGS ON THE SURFACE OF SANDSTONE.



[illegible] ON THE SURFACE OF SANDSTONE.

New Red Sandstone, I have sent you a photograph (Pl. IV.) of the surface of the slab, showing both large and small marks, just as if an old hoofed animal and several young ones had crossed the sand. The slab is 15 inches by 12; and as it has formed part of a pavement in the village of Crook for about seven years, it has been somewhat foot-worn. The sandstone from which the slab comes is thick-bedded and good for building above, and laminated lower down in layers from 1½ to 4 inches thick, of a whitey-brown colour, and used for flagging. The marked surfaces of the sandstone are often covered by a seam of sandy clay from 1 to 3 inches thick. —Yours, &c. JOSEPH DUFF.

HUNTER-HILL COTTAGE, ETHERLY, near BISHOP-AUCKLAND: *Dec.* 14, 1864.

NOTE.—Semicircular impressions, with a raised border, but of larger size than those noticed by Mr. Duff, have been described by Mr. Babbage, in the Proceed. Geol. Soc., vol. ii. p. 439, as occurring in the Farewell Rock (Millstone-grit) of South Wales; and others have been noticed in the Old Red Sandstone of Forfarshire, where they have been known as 'Kelpies' Feet.' (Lyell.)

The sand resting against stranded *Medusæ* on a beach, and against the hoof-shaped egg-cases of *Naticæ*, has been suggested (by Lyell) as a possible cause for such markings.—EDIT.

EXPLANATION OF PLATE IV.

Surface-marks on a slab of Carboniferous Sandstone, from near Bishop-Auckland, rather less than half the natural size. Fac-simile (on zinc) of a Photograph.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—May I be allowed to suggest that part of the GEOLOGICAL MAGAZINE be devoted to *Notes and Queries*? They would prove a source of much interest to country Geologists, and form a medium of communication between distant subscribers. No doubt many points of interest are lost from the fact that local observers have no medium through which they may explain their doubts and confess their ignorances. Would you, Mr. Editor, put yourself out of the way to answer questions touching facts of geological interest, not generally known, and will you allow me to close this letter with one or two queries?

1. What is the present generally received opinion as to the origin and formation of Flints in Chalk; and where can I find the *latest* accounts of them? [See the Report of the Norwich Geological Society, at p. 132; also Lyell's new edition of the 'Elements of Geology' just out.]

2. Which is the highest chalk in England, and what relation does it bear to the Maestricht Beds? [The Norwich Chalk; but somewhat older than that of Maestricht.]

3. Required a classified stratigraphical account of the Chalk-formation. [See the Notice of M. Reynès' Memoir, at p. 113.]

Yours, &c., G. D.

P.S. I have consulted Conybeare and Phillips's account of the Chalk of Dover and Thanet, Mantell's account of the Geology of Sussex and S. E. of England, and Sir C. Lyell's 'Manual of Geology,' 5th edition and Supplement, 1857, on this subject, and am asking for later information.

[Instead of replying at large to the above queries, the EDITOR refers to the indicated articles in the GEOLOGICAL MAGAZINE, and will be glad to receive replies from Correspondents.]

BELGIAN BONE-CAVES.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—In a recent number of the 'Times' there is an extract from 'Galignani's Messenger,' stating that, in a paper addressed to the Belgian Academy of Sciences, M. Van Beneden gives an account of some *human* and animal remains discovered by him in a grotto in the Valley of the Lesse. The human bones were found together with those of bears, oxen, horses, *reindeer*, beavers, several beasts of prey, birds, fish, &c.

You would greatly oblige many of your readers if you would give them some account of this grotto, and the fossil remains found in it, and state *your* theory with respect to them. Your obedient servant,

THOMAS DAWSON.

LONDON: *January* 18, 1865.

Note.—Brief notices by M. Van Beneden of this and neighbouring bone-caves are given in the 'Reader' of Jan. 7th and Feb. 11th. The points of special interest appear to be:—1. The discovery of another district, besides that of Central and Southern France, where the *Reindeer* (now confined to Arctic regions) existed with Man in prehistoric times; 2. The finding of well-preserved bones (especially skulls, indicating possibly two races) of the Men of that period; 3. The probability of water having flooded the cave since its contents were deposited therein; 4. The height of the cave above the Lesse (some 40 yards) in the cliffs of Mountain-limestone, without any other entrance than in front.

If the river flooded the cave, a great change of level must have been brought about in the valley since Man first inhabited it; but without further details, or personal inspection, it is impossible to form a definite opinion as to the mode of occupation of these caves, and of the imbedding of the bones, &c. Probably, as in the South of France and elsewhere, the old people lived by the chase, keeping their food and cooking it in the caves, and leaving bones, shells, tools, and weapons, broken pottery, &c., mixed up with the rubbish and dirt: accident, neglect, and massacre may have left human bones in the same refuse-heaps. Such caves were entered by rough-cut steps, and natural ledges, with holes for wooden pegs, and perhaps ropes of hide or sinew were used: rain and frost, however, have removed such surface-marks. These Belgian caves yield *pottery*, which is unknown as yet in the Caves of Dordogne.—EDIT. G. M.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—In Greenough's Geological Map of England and Wales, a 'Burning Well' near Broseley is noted. Can you tell me if it still exists, or something of its history?—SALOP.

DISAPPEARANCE OF AN ISLAND.—The Indian papers report that one of the Maldive Islands, about 100 miles from Cannanore, on the Malabar coast, has suddenly disappeared. Such a phenomenon is not of unusual occurrence, it is said, several islands having been seen by the crews of vessels to sink. The Rajah of Cannanore, it appears, is a loser to the extent of three lakhs of rupees by this casualty. Some fishermen living on the island went out in the morning; on their return in the evening they found that their homes were gone. Are these islands altogether formed of Coral? and do they fall away by being undermined by the sea?—ENQUIRER.

MISCELLANEOUS.

At the Annual Meeting of the GEOLOGICAL SOCIETY OF LONDON, on February 17, W. J. Hamilton, Esq., President, in the chair, the Secretary read the Reports of the Council, of the Museum and Library Committee, and of the Auditors.

The remarkable increase in the numbers of the Society and the condition of the Society's finances were stated to be very satisfactory. The President announced the award of the Wollaston Gold Medal to Thomas Davidson, F.R.S., &c., for the highly important services he has rendered through many years to the Science of Geology by his critical and philosophical works on Fossil Brachiopoda; and, in handing the medal to that distinguished Palæontologist, he commented on the valuable contributions to science furnished by that gentleman to the volumes of the Palæontographical Society, remarking that their value was much enhanced in consequence of the illustrations having been drawn by the author himself. Mr. Davidson, on receiving the medal, requested the President to convey his sincere thanks to the Council for the great honour they had done him by this award, which was the more welcome as it came to him from the hands of one who is at the same time the President of both the Geological and the Palæontographical Societies. The President then stated that the balance of the proceeds of the Wollaston Donation-fund had been awarded to J. W. Salter, Esq , F.G.S., &c., in recognition of his valuable services in the elucidation of Palæozoic fossils, and to assist him in completing his Monograph on British Trilobites, and placed it, together with a diploma to that effect, in the hands of the eminent recipient. Mr. Salter briefly thanked the Society for this testimony of their approbation.

THE SOUTHERN COUNTIES ASSOCIATION for the Encouragement of Agriculture, Arts, Science, Manufactures, and Commerce, lately established, will have for the second of its five Departments

—Natural History, Local Geology, Botany, and Horticulture. The Meetings will be held in the counties of Hants, Berks, Oxford, Surrey, Sussex, and Kent, in succession. The counties of Wilts, Dorset, &c., are already included in the Bath and West of England Society.

FOSSIL-HUNTING Geologists may like to be informed that the late gales have laid bare a vast tract of the line of cliffs extending between Milford and Christchurch, known as the Barton and Beacon Cliffs, abounding in marine and freshwater deposits, of Middle and Upper Eocene Age. The late gales have also wrought a great change in the shingle-bed connecting Hurst Castle with the main-land. This natural breakwater, 200 feet high, has been broken through by the sea, and Hurst Castle at high water now stands on an island.

Burntisland also, in the Firth of Forth, has had its shores much affected by the storms of this winter.

A NEW COAL-FIELD IN YORKSHIRE.—An important discovery, likely to change entirely the aspect of the district, is stated to have been made in the Vale of Mowbray, near Thirsk, North Riding. At a place known as 'Nevison Farm' it has been found that coal exists; and as the geological contour and formation are much like that of the great Durham Coal-basin, it is conjectured that the southern limit of that deposit may be at Thirsk. It is further reported that signs of the existence of copper-ore had also been discovered in the same neighbourhood. Of course the discovery of coal in so close a proximity to the great ironstone-deposits of the Yorkshire Moorlands would be of the highest benefit to that district of the North Riding.

ENTOMOSTRACA IN COPROLITES.—A very fine take of a rare and comparatively large Entomostracan—*Cypridina Rankineana*—has recently been made by Mr. John Young, of Glasgow. In breaking up a coprolite from a shale-bed in the Lower Carboniferous series at Carluke, he obtained no less than 300 specimens of this species; nearly all of them perfect and well preserved. The coprolite was two inches in length and one inch in breadth. Previous to the discovery of these specimens, only a single example of this *Cypridina* was known to exist.

Note.—This association of Bivalved Entomostraca and Fishes reminds us of Dr. Baird's remarks 'on the food of some freshwater Fishes,' in the Berwicksh. Club Transact., where he describes at least two new species got out of the stomachs of Trout.—EDITOR.

TRIASSIC REPTILES IN THE NATIONAL COLLECTION.—The British Museum has recently secured the unique and interesting remains of *Teratosaurus Suevicus*, found in the Upper Keuper Sandstone near Stuttgart, and described and figured by Hermann von Meyer in the 'Palæontographica,' vol. vii. p. 258, pl. xlv.

The only remains of this singular Triassic Reptile at present known are a portion of the head (consisting of the maxillary, nasal, and orbital bones), two detached teeth, and probably a coracoid. The maxillary has thirteen alveoli, at the base of each of which is a large external vascular foramen for the passage of the nerves and vessels from the dental canal to the outer integuments, and by which the base of the enclosed teeth are visible: of these there are several *in situ*, either fully developed or as germs. The teeth are the most interesting portions preserved, as they possess all the external characters of those of the *Megalosaurus*, and detached specimens might easily be mistaken for teeth of the latter reptile. According to H. von Meyer, the remains are of true Lacertian type, having some affinities to the existing genera *Stellion* and *Uromastix*.

From the same collection and locality were also obtained the fragmentary remains of the equally rare Chelonian Reptile *Chelytherium obscurum*, von Meyer.—W. D.

SUDDEN DESTRUCTION OF MARINE ANIMALS.—Having often been puzzled to comprehend the manner in which, in some instances, large numbers of marine animals, such as Cuttle-fishes, Crabs, Lobsters, and even Fish and Reptiles, have in past ages suddenly perished in their own element and been entombed, probably on or near the *very spots* where they had been hatched, and which they had frequented all their lives, it has occurred to me that any suggestions as to causes now in operation which might have produced then, as now, the same result, will not be unwelcome to the Geological student. In the 'Principles of Geology' (7th edit. 1847) Sir C. Lyell mentions (p. 743), among other causes, the shifting of currents, which might result in the carrying away of banks of sand and mud, habitats of vast colonies of cockles and other mollusks; and the effect of a storm in tearing up and casting ashore from their more solid bed great heaps of the edible oyster in the estuary of the Firth of Forth in 1831, and numbers of living whelks.

At Stornoway, in the Island of Lewis, the largest of the Hebrides, is a depôt for Fishermen, from whence vast quantities of Lobsters are every week despatched by steam-packet to Glasgow (a distance of 250 miles). These crustaceous delicacies are not packed until the latest moment, being required to reach London 'strong alive.' During the week the daily 'catches' are placed in large wooden boxes (perforated on every side so as to allow a free current of water to pass through them), and sunk in the sea at the end of the pier within the bay. On one occasion, when more than 1,000 lobsters had been so boxed up, a heavy fall of rain during the night brought down so much fresh water that in the morning every lobster was found dead, and the whole were sold, at a heavy loss, within the island.

My friend Mr. Day, of Charmouth, informs me that after the sudden thaw at the end of January and the beginning of February this year, such large floods of snow-water flowed into the sea along the Dorsetshire coast, that immense numbers of the 'Poulpe' (*Octopus vulgaris*) have been killed and washed ashore at Charmouth. Is it not probable that these sudden influxes of fresh water—especially when at a much lower temperature, and charged with sediment—may have produced similar results in past times, as now, and may to a great extent explain the occurrence of marine organisms in a very abundant and unusually perfect state?—H. W.

Note.—Sir W. Denison has remarked (Geol. Soc. Journ., vol. xviii. p. 453) that the great rains of the S.W. Monsoon periodically destroy millions of fish and other marine creatures off the coast of India. Severe frosts during low tides are highly destructive to the Littoral zone of sea-life, as noticed by Hugh Miller and others; and Volcanic emanations also destroy animals and plants far and wide in both deep and shallow seas.—EDIT. GEOL. MAG.

SOUTH KENSINGTON MUSEUM.—A large part of the collections illustrative of building materials and construction, recently exhibited in the temporary iron building at South Kensington, has been removed to the South Arcades of the Royal Horticultural Society's Gardens, where it will be again exhibited to the public, and the usual facilities for study and comparison afforded, as soon as the necessary arrangements can be made.

OBITUARY NOTICE.

HUGH FALCONER,* A.M., M.D., F.R.S., F.L.S., F.G.S., VICE-PRESIDENT OF THE ROYAL SOCIETY, AND FOREIGN SECRETARY OF THE GEOLOGICAL SOCIETY.—We have this month to record the death and to give a dim outline of the outer life of one of the first palæontologists of the day. Would that it were in our power to penetrate a little more deeply beneath the surface he showed to society! But, though regretting that we cannot give a more definite picture of his mind, we rejoice at being enabled to sketch, even thus faintly, some of the principal results it produced.

Hugh Falconer was born, on February 29, 1808, at Forres, near the banks of the Findhorn, in the North of Scotland. In the Grammar School of that town he commenced his education, and afterwards studied for four years at the University of Aberdeen, receiving in due course the degree of A.M. He then studied medicine and natural history for a similar term at the University of Edinburgh; his early taste for the latter subject being greatly stimulated by attendance on the lectures of Professors Jameson and Graham. He then received, in 1829, the degree of M.D., and obtained the diploma of the Royal College of Surgeons of Edinburgh. Being immediately appointed an Assistant-Surgeon on the Bengal Establishment, but not having reached the required age of twenty-two, he employed the interval in botanical and geological studies; and this led the way to his first contribution to palæontology.

In the Museum of the Geological Society of London, Dr. Falconer was enabled to study some remains of fossil Mammalia from

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* Many of the incidents contained in this sketch are taken from a very complete notice which appeared simultaneously in the 'Reader' and 'Athenæum,' for February 11, 1865.

Ava, the description of which, by Mr. Clift, was then exciting considerable interest; and soon after his arrival in Calcutta, he himself undertook the description of another collection of fossil bones from the same country, and published a paper on them in 1831.

Having thus broken ground, he was not slow in following up the line of inquiry he had commenced; and in the following year, in company with Captain, now Sir, Proby Cautley, he began the Exploration of the Sewalik Hills. This investigation led to such important results, that in 1837 the Council of the Geological Society awarded Dr. Falconer and his coadjutor the 'Wollaston Medal,' the highest honour, purely geological, that a geologist can receive, and a fit reward for the successful carrying out of a difficult investigation in the midst of arduous official duties. At this time Dr. Falconer was Superintendent of the Suharunpoor Botanic Garden, and consequently prosecuted a variety of botanical researches, chiefly in connection with the subject of tea-cultivation in India. It was on one of the Exploring Expeditions to which he was attached at this time, that he examined the great Indian glaciers; and what he then observed he recently used with great effect in the discussions on the glacier-erosion hypothesis, of which he was a strenuous opponent.

In 1843, Dr. Falconer arrived in England on sick-leave, and while here he found ample occupation in arranging his Sewalik collections, in the British Museum and the India House. He also commenced the celebrated 'Fauna Antiqua Sivalensis,' of which nine parts of the Atlas were published; but unfortunately only one instalment of the descriptive letter-press ever appeared. Besides this great work, he published a number of memoirs on different portions of the Sewalik fossil fauna, and some botanical papers. In 1847, his leave having expired, Dr. Falconer returned to India, and the year following, on the retirement of the late Dr. Wallich, he was appointed Superintendent of the Calcutta Botanic Garden. Botanical questions connected with his duties now occupied most of his time; but in 1854, in conjunction with Mr. Henry Walker, he undertook a 'Descriptive Catalogue of the Fossil Collections in the Museum of the Asiatic Society of Bengal,' which was published separately in 1859. Retiring from the Indian Service in 1855, he returned to England, visiting the Holy Land, Turkey, and the Crimea, *en route*.

Now began the series of researches which has of late years rendered Dr. Falconer's name so famous, and his opinion so authoritative. In 1857, the first part of a memoir 'On the Species of Mastodon and Elephant occurring in the Fossil State in England' was published in the Quarterly Journal of the Geological Society (vol. xiii. p. 308); it was quickly followed by the second part, which, however, was only published in abstract. This is also the case, most unfortunately for palæontology, with the majority of his succeeding memoirs, the chief exceptions being the two papers on *Plagiaulax*, and a farther memoir on Elephants (Natural History Review, 1863).

During the last few years Dr. Falconer devoted himself almost exclusively to the question of the Antiquity of Man; and everything he did in this subject was rightly looked upon as highly important.

On his return from Sicily, in June 1859, the results of his labours in the Grotto di Maccagnone were laid before the Geological Society at an Extraordinary Meeting, so important were they deemed by the Council of the Society; while the great interest they excited amongst geologists generally was made manifest by the audience on that occasion being perhaps the most numerous in the recollection of the oldest Fellow; and on this occasion many understood for the first time, both how flint flakes fit for use could be prepared, and their *Geological* value as evidence of the Antiquity of Man. As we have already remarked, it is most unfortunate that he published only short abstracts of his researches on the Grotto di Maccagnone, the Gower Caves, and many other subjects.

The very last subject of his investigation was the nature of the Canadian fossil elephant (the so-called *Elephas Jacksoni*). Sir W. E. Logan had caused a cast of the original specimen, comprising the whole of the right ramus of the lower jaw, and a portion of the left, to be taken, and sent to England for the purpose of obtaining Dr. Falconer's opinion on its specific affinities. Scarcely more than a fortnight before his death, he spent nearly three hours at the Museum of the Geological Society in a patient examination of this cast; but, with his habitual caution, he declined to give any opinion as to the species of Elephant to which the Canadian fossil belonged. He died on the morning of the 31st of January, and was buried at Kensal Green Cemetery on February 4th.

That Dr. Falconer was a great palæontologist no one doubts. He was also a most original thinker, eloquent and fluent as a speaker, logical in argument, and cautious and scrupulously exact, as a palæontologist should be. His opinion was always received with a remarkable degree of deference; for he spoke with authority, his statements being based on original research, with a wide and critical knowledge of the labours and opinions of others, used with judicious caution, and conscientiously acknowledged. His wonderful command of language, his scorching satire, and his readiness at repartee, made him a most formidable opponent both in debate and in written controversy, and several of his hard hits doubtless linger in the minds of those who have been so unfortunate as to hold opinions 'diametrically opposed' to his own.

Notwithstanding this, he was remarkably kind, even fatherly, to young men who sought his advice. In such cases he took as much trouble to master the whole question as he would have done had it been of the greatest scientific or private importance; and we doubt not that most of the younger followers in his footsteps have some special cause for remembering with gratitude and affection the name of Hugh Falconer.

THE

GEOLOGICAL MAGAZINE.

No. X.—APRIL 1865.

ORIGINAL ARTICLES.

I. Description of Portions of Jaws of a large extinct Fish (*Stereodus Melitensis*, Ow.), probably a 'Cycloid' with 'Sauroid Dentition,' from the 'Middle Beds of the Maltese Miocene.' With a Woodcut.

By Prof. Owen, F.R.S.

SPECIMENS indicative of large 'cycloid' Fishes, with teeth of 'sauroid' character, have been obtained from the 'Upper Chalk' of England. To a species of this kind, with large circular scales covered with minute asperities visible by the aid of a pocket-lens, Agassiz assigned the generic name *Pachyrhizodus*, in reference to the thickness of the base of the anchylosed teeth.

A portion of upper and lower jaws of a Fish of this character has been submitted to me, for examination, by A. Leith Adams, M.D. The specimen forms part of a larger proportion of the skeleton of the same fish, from the middle beds of the Maltese Miocene, now in the Museum of the Malta University.

The teeth, with crowns from 7 to 8 lines in length, are conical, slightly curved toward the inner (?) side of the jaw: sharp-pointed, with a full elliptical, in some almost circular, transverse section. The surface of the crown is smooth; the hard polished enamel is most conspicuous near the apex; a very thin, less bright glazing is continued to the base of the crown, which rather suddenly swells into the part confluent with the substance of the jaw. At this part the tooth is solid and compact: the diameter averages 3½ lines by 3 lines. In a specimen of *Pachyrhizodus basalis*, Dixon,* the base of the teeth is proportionally more expanded, and in most of the teeth the crown is here hollow: the teeth are also close-set. An extent of three inches of the alveolar part of the jaw includes eleven teeth: whereas in the Maltese fossil the same extent includes only four teeth, the bases of the teeth being of nearly the same size in both specimens, and in a portion of jaw of the same size and coarse fibrous structure.

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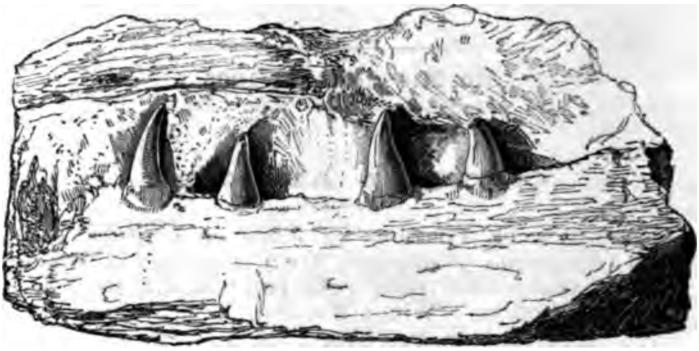
* The Geology and Fossils of the Tertiary and Cretaceous Formations of Sussex, 4to. 1850, p. 347, pl. 34, figs. 2, 10, 10*.



Portion of the Jaws of *Stereodus Melitensis*, Ow. (Reduced one-third.)

Of the four teeth in the Maltese specimen, the interspace between the middle two teeth is nine lines, and between the two near the end of the part measured six lines. This wide spacing of the teeth, with the shape of the crowns and the general size of the specimen, led to its being regarded, in the Maltese Museum, as 'belonging to a Crocodilian,' under which impression the portion of the specimen was transmitted to me. But the mode of the fixation of the teeth shows the fossil not to be of the Crocodilian order, and the osseous tissue of the jaw militates against its reference to the extinct order of Reptiles with anchylosed teeth, to which the *Mosasaurus*, for example, belongs.

In the portion of the jaw opposed to that which contains the four teeth, the impressions in the matrix show the shape and size of the crowns of five of the teeth which it contained; and the fractured base of one of these demonstrates its compact solid texture at that part. These five teeth occupied a space of about three inches. Two of the teeth have been only a line apart: between other two a space of five lines intervenes, and that of eight lines between the two that are most remote from each other.

Dr. Adams writes to me, that the portion of the skeleton of this (supposed) 'Crocodilian' ends abruptly at the tenth dorsal vertebra.

It measures 22 inches in length. The vertebræ are apparently cup-shaped, and average an antero-posterior diameter of from

1 inch to 1¼ inch. Each vertebra has a long flattened spine upwards of 3½ inches in length. The snout apparently was 7 inches in length; the teeth not seemingly all of the same length, and at irregular distances between each other.

The 'cup-shaped vertebræ,' no doubt, indicate the deeper conical cavity of the terminal articular surface of the centrum, which distinguishes that part of the skeleton of the fish from the vertebræ of amphicœlian *Crocodilia,* of which, by the way, we have hitherto had no evidence in formations more recent than those of secondary geological age.

Like the *Pachyrhizodus,* the present Miocene Fish is most probably a Cycloid with sauroid dentition. The almost circular section of the teeth differentiate it from the large extinct 'Sphyrænoid Cycloids,' *Sphyrænodus, Hypsodon, Saurodon, Saurocephalus,* &c. It differs, by so much of the dental character as opportunity has been given me of comparing, both specifically and generically, from *Pachyrhizodus basalis*; and I propose to indicate this fine addition to Miocene Tertiary Fishes by the name of *Stereodus** *Melitensis.* It is much to be desired that the rest of the skeleton of this extinct Fish should be figured.

II. A FEW MORE WORDS ON THE LAURENTIAN ROCKS, AND THE PROOFS OF THEIR EXISTENCE IN BRITAIN.

By Sir RODERICK I. MURCHISON, K.C.B., F.R.S., &c.

IN my observations on the Laurentian Rocks of Britain which appeared in the last number of the GEOLOGICAL MAGAZINE, there is one statement which calls for modification, and another which I revoke. The striking discordance of direction or strike between the true Laurentian rocks of the North-Western Highlands and Islands, and the superficial strata of Cambrian and Lower Silurian age as described by me, is undoubtedly correct; but in another paragraph it is inadvertently said that the Silurian rocks of Britain trend *everywhere* from NE. to SW. For 'everywhere' the word 'usually' should have been employed, as there are tracts wherein these rocks unquestionably range from W. to E.

The essential point, however, to which I now call the attention of geologists is, that on reviewing my own notes upon and sections of the Connemara Mountains of Ireland (made in 1851), I am quite satisfied that the green serpentinous marble of that district, in which a Foraminifer supposed to be the *Eozoon Canadense* is found, is unquestionably of Lower Silurian age, and is not, as was surmised it might prove to be, a true Laurentian rock.

My friend Professor Harkness, who has examined this tract more recently than myself, has written to me expressing his conviction that the Bins or Pins of Connemara are, as I had laid it down in 'Siluria,' simply prolongations of the quartzose and micaceous altered Lower Silurian rocks of the Highlands of Scotland.*

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* From *στερεός, solidus*; *ὀδούς, dens.*

The crystalline green limestone of Connemara is, in fact, encased in quartz-rocks; and, according to my own observation, it has a strike from W. by N. to E. by S., or nearly E. and W. But, far from being discordant to the direction of the overlying Middle Silurian strata with their characteristic fossils, you perceive, as you pass from the quartz-rocks with limestone through mica-schists to the fossiliferous beds, which are slightly transgressive to those beneath them, the whole ascending series has a general strike from E. to W., and a decided dip to the north. This is clearly seen as you travel from Clifden to the magnificent marine bay of the Killeries.

As to the presence of an *Eozoon* in the Lower Silurian rock, I find by a letter from Mr. W. A. Sanford, that he entertains doubts as to the identity of the Canadian and Irish forms. 'Further experiments (he adds), which are not yet concluded, lead me to believe that while the Canadian form is an immense Nummuline, the Irish one is analogous to a Rotaline, very like a gigantic Polytrema. In both we have the confluent cells; and, to a certain extent, the structure of both is in one part in layers, and in another acervuline. In the Irish fossil there is but little if any trace of the beautiful canal-system so striking in the *Eozoon Canadense*, the shell-structure being entirely tubular.'

It will doubtless be satisfactory to palæontologists if, as Mr. Sanford suggests, the Foraminifer of the Lower Silurian of Ireland should be found to be dissimilar to that of the Laurentian rock of Canada. But I beg to say, that, if the two be found to be identical, the green marble of Galway will still remain a true Lower Silurian rock, as proved by stratification and the range of similar strata from the NW. of Ireland into the Highlands of Scotland.

The persistence of so low an animal as a Foraminifer through vastly long periods is a fact well known to geologists. Thus we know that a *Globigerina* which lived in the Cretaceous age is still alive! Nay, even in the Lower Silurian green sand of Russia we see silicated remains of Foraminifera indistinguishable from recent forms.

Viewed, therefore, by itself only, the mere presence of *Eozoon Canadense* cannot be taken as a proof that the rock in which it occurs is of Laurentian age. Geologists require the further evidence of the infraposition of such rock to Cambrian and Silurian strata. On this principle, the Canadian rocks were called Laurentian by Logan long before an *Eozoon* was found in them. So also the basement-rocks or Fundamental Gneiss of the North-Western Highlands will remain of true Laurentian age, albeit no *Eozoon* may ever be found in them.

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* See 'Siluria,' last edition, p. 190 (not p. 100, as stated in the last number of the GEOLOGICAL MAGAZINE).

III. On the Crags of Suffolk and Antwerp.[*] (Part II.)

By E. Ray Lankester, Esq.

Relations of the Crags of Antwerp and Suffolk.—Having thus passed through the various strata, we may inquire what relation the three Crags bear to the Suffolk deposits. The lists of *Mollusca*[*] which I have carefully compiled from the researches of Mr. Searles Wood, on the one hand, and of M. Nyst, on the other, have been revised by my friend Dr. S. P. Woodward, and will enable us satisfactorily to determine this point. A short list of the *Mollusca* of the Antwerp Crag was published by Sir Charles Lyell in 1852, in his comprehensive and admirable paper on the Belgian Tertiaries; but although the comparison was made with the English beds, yet, in the absence of any section showing the superposition of the Antwerp Crags, and also on account of the imperfections in the list of Shells, the results then obtained cannot have so much value as those which have since been arrived at, and which give the proportions of recent and fossil forms in the five beds under consideration, thus:—

In the Red Crag, 45 *per cent.* of the *Mollusca* are extinct.
„ Coralline Crag, 50 „ „ „
„ Upper Antwerp Crag, 47 „ „ „
„ Middle Antwerp Crag, 59 „ „ „
„ Lower Antwerp Crag, 65 „ „ „

This undoubtedly shows that the Red and Coralline Crags of Suffolk and the Upper Crag of Antwerp are far more closely connected with each other than any one of them is with the Middle or Lower Crag, or than these latter are with each other: and on this account the Red, Coralline, and Upper Antwerp Crags may be considered as Upper Pliocene; the Middle Antwerp Crag, as Middle Pliocene; and the Lower or Black Crag, as Lower Pliocene. If the total number of species as yet discovered in each bed be examined, it is found that the Red and Coralline Crags of Suffolk have the largest numbers; most probably because they have been the best searched. The numbers are—Red Crag 231, Coralline Crag 299, Upper Antwerp Crag 115, Middle Antwerp Crag 117, Lower Antwerp Crag 163. Until the other day, the fauna of the Black Crag appeared as scanty as that of the two higher Crags of Antwerp; but M. Nyst, having directed his researches to a deposit at Edeghem, swelled its lists in the same way as it is quite possible that the number of known *Mollusca* in the Upper and Middle Crags may be increased.

A Table showing the results to be derived from the lists of *Mollusca* is added to this paper. There being two sets of figures, one for the extinct species, and the other for living species, it will be seen that there are but 9 extinct and 17 living species which run through all the strata; whilst there are 60 extinct and 76 living species common to the Red and Coralline Crags; 24 extinct and 37 living species common to the Red, Coralline, and Upper Antwerp Crags. A great number of facts may be gathered in this way from the tabular statement, bearing in an important manner on the relations of the various beds; but in all cases it must be strictly taken into consideration that the total of the known Molluscan Fauna of the Red and Coralline Crags is more than double that of the Upper or Middle Antwerp Crags, and also that the Lower Antwerp Crag has a larger *known* fauna than the higher Crags of Belgium.

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[*] Continued from page 106.

[†] The lists are too long for publication in this Magazine

Relations of the Lower Antwerp Crag.—By some authors the Black Crag of Antwerp has been considered as of Miocene age; by others, as the equivalent of our Coralline Crag. The truth is, no doubt, between the two opinions; and, as above stated, the Lower Antwerp Crag is a representative of a Lower Pliocene period. Besides the species which are common to the other strata, there are some dozen species found in the Black Crag which occur again in the Coralline Crag only; but there can be little doubt that were the Upper and Middle Crags carefully searched, these forms would turn up. An undoubted relation exists between the Black Crag and the higher, so-called Miocene, beds of Bordeaux and Vienna. In fact, the resemblance is so close, that it appears necessary to consider them as belonging to the same epoch. If the higher Bordeaux strata are Miocene, then also are the Lower Antwerp Crags, and *vice versâ*. The Black Crag appears to be inseparable from the Middle and Upper beds. The presence in this deposit of such shells as *Cyprina Islandica*, *C. rustica*, and forty-two others, which are found in the two series above, connects them most intimately: rather than they should be separated, it is necessary to consider the higher 'Miocene' beds of Bordeaux and Vienna as being really Pliocene.

Evidence of the Existence of Middle Pliocene Strata in England.—It may very well be asked—have we no representative, then, of the Antwerp Middle and Lower Crags in this country? As far as regards the Lower Crag, I am afraid the answer must be in the negative; but with respect to the Middle Crag, there is a little more to be said. The catalogue of the Molluscan Fauna of the Middle Crag of Antwerp undoubtedly shows its superior antiquity to the Red and Coralline Crags. M. Van Beneden has described from that deposit numerous remains of *Cetacea*, belonging to the genera *Squalodon*, *Plesiocetus*, *Dioplodon*, *Chonezipхius*, &c., and has also shown me the tooth of a Seal and the fragment of the tusk of an enormous Morse which I have elsewhere called *Trichecodon.*[*] These are associated with the teeth of *Carcharodon megalodon* and others. None of these fossils are sea-worn. Throughout the Red Crag we find much-rolled and worn vertebrate remains corresponding, in species, to those of Antwerp. Can it be doubted that these are the débris of a formation which existed in England formerly, but was broken up by the Red Crag Sea?

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[*] I have lately communicated a notice of the tusk of this animal to the Geological Society, having obtained specimens of it from our Red Crag some time since; and I have proposed to call it *Trichecodon Huxleyi*.

Isocardia cor, Lin., is a very rare shell in our Suffolk Crag; in the Middle Crag of Antwerp it is abundant. Nodules of fine sandstone are abundant in our own Red Crag, containing generally *Pectunculus glycimeris*, an abundant shell also at Antwerp, or frequently *Isocardia cor*, and sometimes a Cetacean tooth. The conclusion is irresistible, that these nodules are portions of lost Middle Crag beds, the equivalents of the Middle Pliocene of Antwerp.

The following may be taken as a synopsis of the formations above treated of:—

Upper Pliocene.
Red Crag; Coralline Crag; Upper Antwerp Crag.
Middle Pliocene.
Middle Crag of Antwerp.
Lower Pliocene.
Lower or Black Crag of Antwerp; *Miocène supérieur* of Bordeaux and Vienna.

I subjoin a list of some of the derivative fossils in the Red and Coralline Crags:—

1. Ammonites, Pecten, &c., from the Upper Greensand.
2. Flint Sponges, Echinoderms, &c., from the Chalk.
3. Lower Eocene Mollusca in nodules, from the Thanet Sand, &c.
4. 'Coprolitic' nodules, and very numerous Crustacea, Teeth, and other Fish remains from the London Clay.
5. Teeth of *Carcharodon heterodon*, and jaws of *Edaphodon*, from Middle Eocene Beds.
6. *Mastodon Arvernense*, *Rhinoceros*, *Tapirus*, *Sus*, &c., from Miocene or Pliocene Beds.
7. *Carcharodon megalodon*, *Rhinchoceti*, *Squalodon*, *Trichecodon*, &c., from Middle Pliocene Beds.
8. (In Red Crag) *Pectunculus glycimeris* and very many other Shells from the Coralline Crag.

(See also Mr. S. Wood's List of the Derived Fossils, Quart. Journ. Geol. Soc., vol. xv., p. 33, &c.)

TABLE SHOWING THE RELATIONSHIPS OF THE SEVERAL CRAGS OF SUFFOLK AND ANTWERP; AS DERIVED FROM LISTS OF THEIR MOLLUSCA.

RC.—Red Crag. CC.—Coralline Crag. UAC.—Upper Antwerp Crag. MAC.—Middle Antwerp Crag. LAC.—Lower Antwerp Crag.

	RC.	CC.	UAC	MAC	LAC	Extinct	Living.	
Extinct species.	9	9	9	9	9	9	—	26 species common to all five.
Living species.	17	17	17	17	17	—	17	
Extinct.	6	6	6	6	—	6	—	18 common to RC., CC., UAC., & MAC., but absent from LAC.
Living.	12	12	12	12	—	—	12	
Extinct.	9	9	9	—	—	9	—	17 common to RC., CC., & UAC., but absent from MAC. & LAC.
Living.	8	8	8	—	—	—	8	
Extinct.	20	20	—	—	—	20	—	56 common to RC. & CC., but absent from UAC., MAC., & LAC.
Living.	36	36	—	—	—	—	36	

	RC.	CC.	UAC	MAC	LAC	Extinct	Living.	
Extinct.	26	—	—		—	26	—	67 peculiar to RC., absent from all the other four.
Living.	41	—	—		—	—	41	
Extinct.	—	83	—	—	—	83	—	140 peculiar to CC., absent from all the others.
Living.	—	57	—	—	—	—	57	
Extinct.	—	—	9	—	—	9	—	10 peculiar to the UAC., absent from all the others.
Living.	—	—	1	—	—	—	1	
Extinct.	—	—	—	13	—	13	—	15 peculiar to the MAC., absent from all the others.
Living.	—	—	—	2	—	—	2	
Extinct.	—	—	—	—	64	64	—	76 peculiar to the LAC., absent from all the others.
Living.	—	—	—	—	12	—	12	
Extinct.	5	—	5	—	—	5	—	11 common to RC. & UAC., but absent from CC., MAC., & LAC.
Living.	6	—	6	—	—	—	6	
Extinct.	11	—	11	11	8	11	—	14 common to RC., UAC., MAC. and (some to) LAC., but absent from CC. and some in LAC.
Living.	3	—	3	3	2	—	3	
Extinct.	17	14	—	17	10	25	—	43 common more or less to RC., CC., MAC. & LAC., but absent from UAC.
Living.	2	15	—	6	18	—	18	
Extinct.	—	—	0	0	0	0	—	1 common to all the Antwerp beds, but absent from RC. & CC.
Living.	—	—	1	1	1	—	1	
Extinct.	—	—	—	6	6	6	—	8 common to MAC. & LAC.; absent from RC., CC., & UAC.
Living.	—	—	—	2	2	—	2	
Extinct.	—	4	4	4	3	4	—	9 common to CC., UAC., MAC. and some to LAC.; absent from RC.
Living.	—	5	5	5	4	—	5	
Extinct.	—	—	2	3	—	3	—	4 common to UAC. & MAC.; absent from RC., CC., & LAC.
Living.	—	—	1	1	—	—	1	
Extinct.	2	3	4	—	5	5	—	7 common more or less to all but MAC.
Living.	1	1	2	—	2	—	2	
	237	299	115	117	163	Total number of species in all the five beds=522.		

IV. On the Connection between the Crag Formations and the Recent North Pacific Faunas.

By P. Carpenter, B.A., Ph.D.

(Read before the British Association, September 1864.)

ALL facts from stray sources bearing on the connection between the Newer Tertiaries and existing faunas are worth placing on record, as they may hereafter unexpectedly throw light on important points of inquiry. The existing faunas radiating from the Boreal districts may, indeed, be expected to have much in common, together with species peculiar to each ocean, and to each side of each ocean; and the correspondence extends to species living in the Temperate and even the Sub-tropical districts. *Kellia suborbicularis, Lasea rubra,* and *Saxicava pholadis* of the Coralline Crag are now living along the whole coast from Vancouver to the Acapulcan district: and *Erato Maugeriæ*, whose head-quarters are now in the West Indies, appeared in the Coralline, did not disappear in the Red Crag, is now living in the Bay of Panama, and is nearly, if not quite, identical with *E. columbella* of the Gulf and the Temperate shores of California. Along the Atlantic shores of the peninsula of Central America are found fossil *Malea ringens*, now living in the Pacific, and other species probably of Pacific origin. The recent shells on the Pacific side have a large intermixture of living West-Indian species, many of which have migrated northwards; *Livona pica* apparently dying out in the Californian seas. There is very little appearance of Pacific creations in the Caribbean seas. Co-ordinately with the Glacial Period of Northern Europe, the ancient West-Indian species were probably poured into the Pacific through the archipelago which has now become a broad peninsula. Between the Tropical and the Sub-boreal seas of the North Pacific, we find many species generally regarded as characteristic of the Atlantic seas; of which only two, *Venericardia borealis* and *Chrysodomus liratus*, are special to the West Atlantic; and several, namely, *Kellia suborbicularis*, *Lasea rubra*, *Crenella decussata*, *Lucina borealis*, *Cryptodon flexuosus*, *Limæa subauriculata*, *Haminea hydatis*, *Cerithiopsis tubercularis*, and *Triforis adversus*, are generally considered special to the European side. It would appear, therefore, that in the early days of existing species, there was much closer connection between the North Pacific and European, than between the East and West American seas. Co-ordinately with this fact, must be noticed that in the Japan seas are found several Mediterranean species not known on the Southern shores of Asia; and of these one is common in the Vancouver district. It will be remembered that the Drift, so plentiful over the bulk of Northern America, is not found on the Pacific slope; and that the bulk of the copious Tertiaries of California are of Miocene age. At this period, the Sierra Nevada is supposed by Conrad to have been an archipelago; yet there is scarcely any connection between the Temperate parallels of East and West America, while the connections with European seas are clearly marked.

The Mediterranean as well as the Boreal species in the Crag are well known; but there are certain generic and specific forms which were formerly considered peculiar, yet are now found to have, if not their descendants, at least their representatives, in the Vancouver and Californian district. This is true of the arrow-sculptured *Acila*, *Miodon* (also found in the Great Oolite), *Verticordia*, and *Solariella*, which are eminently Crag and Californian groups.* The huge *Hinnites Corteysii* finds its counterpart in the Californian *H. giganteus*; *Glycimeris Faujasii*, in *Gl. generosa*; and the little *Sphænia* of the Crag is more like *Sph. ovalis* of Vancouver than *Sph. Binghami* of British seas. Not taking into account *similar* forms, no fewer than 24 Crag species have been already clearly identified on the West

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* *Acila*, *Verticordia*, and *Solariella* are also found in Japan.

Pacific coast. Several of these can scarcely have travelled through Behring Straits, not being Boreal forms. They have not been found in the British parallels, but appear in deep water off the Sta. Barbara group of islands; with other species not found on the continent, in the midst of the Lower Californian fauna, and in company with Tropical forms here finding their northern limit.

These investigations are only just commenced. The results of the Californian Geological Survey are now under consideration; and will doubtless bring to light many points of great interest on the connection between the ancient and the existing faunas.

V. MARINE DENUDATION ILLUSTRATED BY THE BRIMHAM ROCKS.

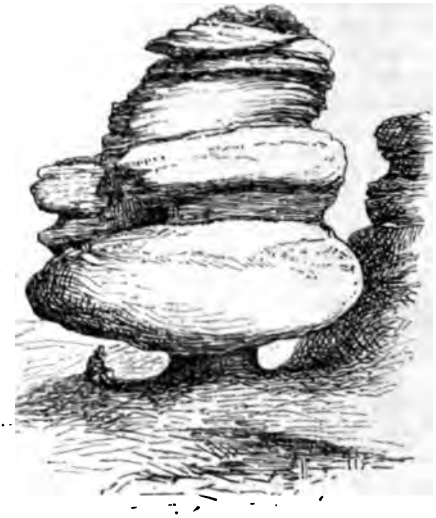
By D. MACKINTOSH, F.G.S.

THE claims of the sea as a denuding agent have been much disputed of late years; the meteoric and fluviatile theories of denudation have been revived; and the glacial theory has been extended, so as to encroach on what was once generally admitted to be the legitimate province of the sea. But, as a forgetfulness of, as well as too much reliance on, the power of the sea to modify, may become a fertile source of hasty and false generalization, it is well that the importance of waves, tides, and currents, as denuding causes, should be re-asserted, and attention directed afresh to the more striking monuments they have left behind them in regions removed from their present theatre of action. These monuments present an unmistakeable resemblance to the cliffs, buttresses, walled inlets, pillars, needles, &c., now in course of being formed by the sea; and in explaining them, the old principle of sound theorization—*similar effects are referable to similar causes*—is not to be set aside by overstraining the capabilities of any theory which will *merely* account for the phenomena. Many of the appearances above mentioned have been attributed to atmospheric agency; and the denuding influence of air, rain, frost, &c. must to a certain extent be allowed. But the action of the atmosphere has not only been applied to the explanation of rocky scenery which is *more obviously* the result of oceanic denudation, but it has, I think, been extended to phenomena which the sea alone could have produced. Meteoric agents, generally speaking, operate from above, and their *mechanical* effects at least are confined to a decrease of level, or the formation of slight inequalities. If we except the chemical influence of air acting imperceptibly on rocks of a certain composition, meteoric agents are inadequate to the production of the following class of phenomena:—caves, with narrow entrances, and large amphitheatres within, indicating a *laterally excavating* agency, such as that of waves and tidal currents,—precipitous cliffs, with blocks of rock in positions, or presenting forms, which could only have been occasioned by the *undermining* action of the sea,—narrow inlets with vertical or overhanging walls,—pillars with slender pedestals,—rocks with nearly horizontal perforations,—and many other conditions which reveal not only a laterally extending, undermining, and even upwardly operating agency, but a cause determined in a particular direction, and which must frequently have assailed the lower part of rocks after the upper had risen beyond its reach. All these and other proofs of *marine*, in opposition to *meteoric*, denudation are strikingly presented by the Brimham Rocks in the West Riding of Yorkshire,—the forms of which most observers have hitherto attributed to weathering, or the hands of man. They are situated about 9 miles from Harrogate and Ripon, 5 from Ripley, and 2 from the Dacre Banks Station. The most interesting way of reaching them is to go by railway to Ripley, and then walk along the Old Pateley Road. On gaining the summit of the first eminence, the rocks present a very imposing appearance, as they rise up with the sky for a background, and are very liable to be mistaken for an irregular clump of trees on the top of the hill. On approaching nearer, what appeared as one of the trees is seen to be a huge pillar of rock, with a projection on the left side. On viewing them from a small knoll on the right-hand side of the road, and about three-quarters of a mile distant, the geologist familiar to sea-coast scenery at once looks upon them as the north-western part of an island which has been partly wrecked by the sea at a former period. A smaller assemblage of ruins may be seen ramifying from the eastern coast of the island; but these are little visited.

The Brimham Rocks (Millstone-grit) are of the same nature, and many of them of the same form, as those described by Mr. Hull in the 'Quarterly Geological Journal' (August 1864), as occurring in the Peak District of Derbyshire in 'groups or multitudinous assemblages.' The table-shape and anvil-shape are common in both localities. Mr. Hull justly calls them '*sea-shore rocks*,' and they are due to the same cause, namely, 'old marine denudation' (p. 253).

Absence of Traces of Human Agency.—Ordinary observers are very liable to err in attributing to man what is chiefly or solely due to nature. Many of the cromlechs, and most of the rock-basins, and rocking-stones, referred to human workmanship, exhibit the clearest traces of the undermining action of water. It is possible, if not probable, that Druids, or pre-historic Fins, or other races, may have used the Brimham Rocks as a temple, and may have increased the resemblance which some of these rocks bear to parts of the human form and other objects. But the evidence that they have been materially altered by human hands is to be sought for in vain. It has been asserted that the marks of tools have been seen on the pedestal of the Idol Rock. I have not detected them; but, allowing their existence, it would not follow that the general or sea-worn form of this rock was the result of art.

Table-, Mushroom-, and Anvil-shaped Rocks.—Many of the Brimham Rocks approximate more or less to these forms. They are largest at the top, and rest on a comparatively slender basis. In these rocks the undermining action of the sea is most strikingly apparent. Some of them look as if the billows had only left them yesterday. The furrows and ridges run along the planes of lamination, as might be expected, and the great furrows often point out the lines of bedding. The so-called Idol Rock, above mentioned, which is about 20 feet high, and upwards of 40 feet in circumference, rests on a pedestal about 3 feet in breadth below, and much narrower above. If the undermining action of the sea had proceeded a few inches farther, this ponderous mass must have fallen, as has evidently been the fate of other masses in the neighbourhood.



The Idol Rock. (The Pulpit Rocks are to the right.)—Brimham Rocks.

Perforated Rocks.—Among these rocks we find holes of various forms and sizes; and the way in which they have been bored may be seen on the sea-coast at the present day. There are two or three nearly circular perforations in the Cannon Rocks, Brimham. One of them is about a foot in diameter, from 20 to 30 feet in length, and almost quite straight. There is a groove along the side of a projecting rock which looks like a continuation of one side of the perforation.

Rocking Stones.—These truly wonderful phenomena could never have been fashioned and poised by human hands, or formed by a vertically operating or atmospheric agent. They number six or seven, four being in one group. Each would appear to be a remaining portion of a stratum which has been denuded all round and beneath, so as to leave them with one or two supports sufficiently small to allow them to be easily set in motion. These stones, and the stones on which they rest, have evidently been one continuous mass of grit, with a line of bedding, into which the sea must have gained an entrance, gradually widening the space between the rock above and beneath. The waves have penetrated where no ancient tools could have reached, leaving the rocking stones all but separated from the blocks below. Their weight would effectually prevent an entire separation.

Ancient Sea-cliff.—Along the north-western side of the risen island I have been describing, there is a winding line of cliff for upwards of half a mile, which forcibly reminds a traveller of what he has often seen on the present sea-coast. The rocky pillars above mentioned would appear to be the remaining portions of the walls of narrow inlets scooped out by the sea, and ramifying from this line of cliff.[*] The joints in the rocks must have given a direction to, and facilitated the progress of, decay. In many places immense blocks of grit have fallen down, or seem ready to fall, having been undermined. That the ocean has been here, appears as certain as it is that the ocean is elsewhere now carrying on a similar work of destruction on *sea-cliffs* still washed by the waves; but these moorland precipices have lost that name, for they have long since been deserted by the sea. On a stormy night, the geologist, as he peers through the opening called the Lover's Leap (near the top of one of the cliffs), on the scattered blocks nearly a hundred feet below, requires little to make him fancy that he can still hear the lashing of the billows, where now all is really silent except the moaning of the winds.

Atmospheric Action.—The traces of atmospheric action are here comparatively trifling. At the bottom of several of the crevices and gaping fractures, a very thin coating of powdered grit may be seen; but, as in some places it could have had no escape, it must be regarded as the measure of denudation effected by the rains during centuries, if not thousands of years. The rock-basins on the upper surfaces of the rocks may have been deepened and widened, some of them perhaps formed, by rain-water, aided by the small loosened quartz pebbles of the grit; but there are instances of similar basins (such as the so-called Kissing Chair) *beneath* the rocks, in situations to which no gyratory action excepting that of the waves could have reached. But the most striking proofs of the resistance offered by the Brimham Rocks to the action of the atmosphere are found in crevices which apparently have been occasioned by the undermining, and consequent displacement, of the rock on one side of a joint, after the upper part of the cliff had risen above high-water mark. One of these, not far from the Lover's Leap, is a fissure of considerable depth, but only a few feet in width. The walls on both sides correspond in shape to such an extent that the minutest pit on one side appears opposite to a similar-sized prominence on the other. Though open to the atmosphere, not a particle of the grit on either side of this fissure would appear to have been disintegrated since its formation; and, judging from the general character of the rocks, we have no reason to suppose that any great fractures have occurred among them since the time they were undermined by the sea, which was probably towards the close of the Second Glacial, or Ice-floe Period[†]

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[*] Capt. Spratt, R.N., has described and figured a remarkable group of pillars of Nummulitic Limestone at Varna, associated with cromlech-like masses, and with vertical rents gradually widening in a neighbouring cliff-like bank, showing the passage-conditions between the fissured rock and isolated columns. Similar peaks and pillars stand beneath the sea on the floor of Varna Bay. Though inclined to believe in these columnar rocks having been shaped by atmospheric action, Capt. Spratt leaves the question open. See Quart. Journ. Geol. Soc., vol. xiii., p. 71, &c. The difference of limestone and sandstone must be borne in mind, when contrasting these shaped rock-masses of Varna with those of Brimham.

[†] In several parts of the Lake District (Great Langdale, for instance), and I have no doubt elsewhere, rocks smoothed and rounded by ancient glaciers have not been visibly roughened by atmospheric agency, though different parts of these

As we gaze on this wonderful group of insular wrecks, varying in form from the solemn to the grotesque, and presenting now the same general outlines with which they rose above the Glacial Sea, we can scarcely resist contrasting the permanence of the 'everlasting hills' with the evanescence of man. Generation after generation of the inhabitants of the valleys within sight of the eminence on which we stand have sunk beneath the sod; and their descendants can still behold in these rocky pillars emblems of eternity compared with their own fleeting career, but fragile and transient compared with the cycle of geological events. Though the Brimham Rocks may continue invulnerable to the elements for thousands of years, their time will come; and that will be when, by another submergence of the land, the ocean shall regain ascendency over these monuments of its ancient sway, and complete the work of denudation it has left half finished.

VI. ON THE PHYSICAL FEATURES OF THE COAL-BASIN SOUTH OF WALES.

By G. PHILLIPS BEVAN, Esq., F.G.S.

THERE is not in Great Britain any coal-field so characteristic as that of South Wales; nor one which in outward appearance so little agrees with the general notion as to what a coal-field should be like. Instead of the barren and monotonous surface that we usually find in Durham, Staffordshire, Lancashire, or Scotland, we find scenery of a high order,—lofty hills, romantic dales, broken scaurs, and woods feathering down to the banks of the streams that run brawling to the Bristol Channel. It is a wonder indeed that tourists do not oftener explore these gems of South-west landscape, particularly as every valley is now accessible by railway. Nor is it merely in scenic interest that the basin is peculiar; for the very physical arrangement which gives the hill and dale enables much of the coal to be won by level, instead of pit, thus forming a marked feature in the economy of the working. It is with regard to this physical geography that I would say a few words, as viewed in relation to the geology of the basin.

If we look at a geological map of the district, we shall find this coal-basin to be of an irregularly elliptical or pear shape, with the broad axis of the pear forming the Monmouthshire and Glamorganshire districts towards the east and middle, from whence a rapid convergence westward, including the remaining part of Glamorganshire and Caermarthenshire, forms the stalk. The boundaries of the basin *outside* the limestone-escarpments are the 'OLD RED' valleys of the Usk and the Towey on the north, east, and west; while the Bristol Channel forms the basis on the south. *Within* the basin the following arrangement prevails:—Sloping southward from

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rocks are of unequal softness, and though they rise up in exposed situations. In discrediting the wonderful extent to which certain rocks may resist the atmosphere, geologists do not take their mossy covering sufficiently into account.

the limestone-escarpment is a tolerably uniform moorland plateau (fig. 1), varying from one to three miles in breadth, and consisting of Millstone-grit overlying the limestone. At the line where the Coal-measures impinge upon the grit, forming what is called 'the North crop,' a marked depression is observed, immediately to the south of which rise, pretty abruptly, lofty ranges of Pennant Sandstone, forming the divisions between the deep parallel valleys through which the rivers that rise in the Millstone table-land run due south to the Bristol Channel. This depression, which therefore cuts at right angles the heads of all these valleys, has been taken advantage of by railway companies to accommodate the population and mineral traffic of the large ironwork towns on 'the North crop.'

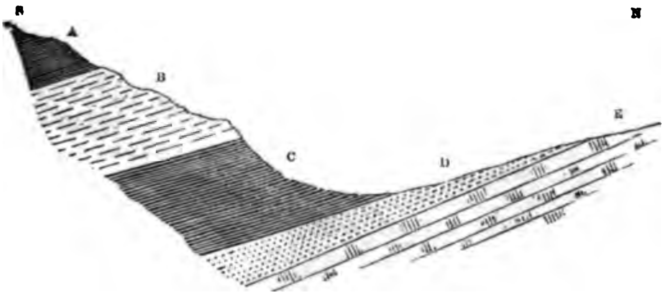


Fig. 1.—Diagram showing the Hills of Pennant Sandstone, with Terraces on the Sides and the Lower Coal-measures cropping out at the foot: the plateau of Millstone-grit is on the right.

A. Coal-measures. B. Pennant Sandstone. C. Coal-measures. D. Millstone-grit. E. Mountain-limestone.

The peculiarity of the Pennant Hills consists in their extraordinary similarity in outline and height, as also in the fact that they are all distinguished by a series of terraces, the remains of ancient beaches (fig. 1).

Commencing at the east, we have, parallel with the limestone belt,

1. The Valley of the Afon, commencing at Blaenafon and leaving the basin at Pontypool.

2. The Ebbw Valleys, running from Beaufort and Brynmawr respectively, converging at Aberbeeg, and emerging at the Risca 'South crop.' (See figs. 2 and 3).

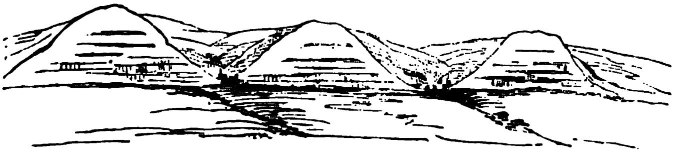


Fig. 2.—View of the Pennant Rocks, from the Millstone-grit Plateau; showing the Terraces and Parallel Valleys. The shading of escarpments below the Terraces indicate where the 'Patch-workings' of the seams on the 'North Crop' have been carried on. The buildings at the heads of the valleys are the Ironworks of Ebbw-Vale and Tredegar.

3. The Sirhowy Valley, from Tredegar, which also joins that of the Ebbw at Risca.

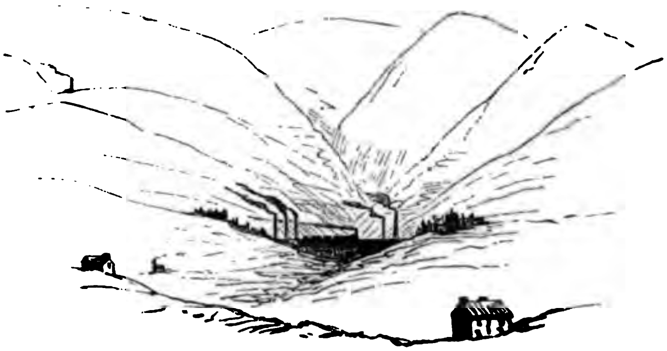


Fig. 3.—View of Ebbw-Vale, looking due South, from above Beaufort; showing the character of the river-valleys and the Pennant Hills.

4. The Rhymney Valley, with its subsidiary, the Bargoed Valley, has its outlet near Cardiff.

5. The Taff Vale, from Merthyr to Cardiff, with its feeders, the Bargoed Taff, the Cynon, on which river the important ironwork town of Aberdare is situated, and the Rhondda Valley, which joins the Taff at Pontypridd, and runs from thence in a north-westerly direction towards the Neath Valley.

So far there is a striking parallelism and uniformity in all these valleys; but after crossing the Taff we find the country more disturbed, and the physical features altered. This is principally owing to the Vale of Neath, which, though rising in the same horizon, and indeed not far from the Taff, takes a west-south-west direction to the sea. The triangular district thus formed is watered by streams of shorter course and smaller volume, such as the Ogmore, the Llynvi, and the Afon, which flow through much more contracted valleys. But the Neath Valley once past, the parallelism is re-established; the Tawe, the Lloughor, and the Gwendraeth Rivers flowing tolerably due south, to enter the channel at Swansea, Lloughor, and Kidwelly respectively. So much for the river-valleys. If we take the long axis of the basin, we shall find two depressions intersecting the river-valleys at right angles: 1. The one described as the 'North crop;' and, 2. A more important one, commencing at Pontypool, and running past Crumlin, Newbridge, Blackwood, and Quaker's Yard, where it is deflected to the south; as far as the latter place, the Great Western Railway has seized it as vantage-ground to tap the centre mineral district, and to reach Merthyr and Aberdare. I have given these features somewhat in detail, as it is necessary to bear them in mind when speculating on the cause of the arrangement. Sir Henry De La Beche, in his masterly *résumé* of the Formation of Rocks in the South-West of England ('Memoirs, Geological Survey,' vol. i.), points out that a tremendous force has acted on the Coal-basin from a westerly direction—in other words, from what is now Ireland—and that, as might naturally be expected, its effects would be strongest and most obvious the nearer to its source, and would decrease as the radius became wider. Accordingly, we find that the Pembrokeshire beds are contorted and displaced more than any others, while the disturbances are evidently lessened as we go eastward. If we suppose a large area of tolerably uniform surface of clays and shales, more or less recently deposited, and then apply to it a pressure (either sudden or long-continued) in any given direction, we shall find that a general rumpling or ridging of the surface would take place; such ridges assuming a certain amount of parallelism to each other, and depending on the direction from whence the pressure was exerted.

The general arrangement of the physical features of the South-Welsh Coal-basin, then, are probably due to the action of this south-westerly force during the deposition of the Coal-measures. I say *during* the deposition, because I cannot help thinking that it took place prior to the deposition of the Upper Measures, and subsequent to the Lower and Pennant beds. It is probable indeed that the whole chemico-dynamical force to which the lower beds were subject caused those alterations in the coal by which the beds have become steam-coal,—an alteration which has given South Wales such a pre-eminence as a steam-coal basin. Whether or not the Steam-coal-measures are due to this, there is no question but that the Upper Measures, where found, are of a totally different character to the Lower Measures. In Pembrokeshire, where the force was exerted most, we find trap-rocks in the immediate vicinity of the coal: also, we find that in Ireland, where the force is assumed to have originated, the same identical Lower Measures are all anthracitic. It may be, however, that the force originated in Pembrokeshire, or at a point half-way between that and Ireland, so as to cause the anthracitic qualities to be formed on either side of it; just as a disturbance in water causes a ripple on every side equally. In Pembrokeshire and Caermarthenshire, the anthracitic quality gradually, but surely, decreases as we get eastward; and finally, in the neighbourhood of the Rhymney Valley it is lost altogether; the coals thence to the 'East crop' being entirely bituminous. At Aberdare and the Vale of Neath, which is about half-way between Caermarthenshire and Rhymney, we find, as we might expect, the highest and most profitable development of steam-coal, being neither too anthracitic nor too bituminous; where we *do find* the upper Coal-measures, as in the neighbourhood of Swansea and Llanelly, they are bituminous, showing the very reverse of the anthracitic quality, and that they could not have been subjected to the same treatment as the Lower Measures. I therefore conclude that the great chemico-dynamical force which operated on the steam-coal, and in all probability gave the coal-field its physical features, took place *prior* to the deposition of the Upper Measures. Almost every one, if not every one, of the parallel valleys has a main fault, generally known in the neighbourhood as the 'big fault,' running through the Lower

Measures, but which does not particularly affect the Upper Measures, where they are found. For instance, in Monmouthshire, the Upper Measures are represented by only one seam of coal, all that is left from the effects of denudation. This is the 'Mynyddwslwyn vein of red ash,' or 'house-coal;' and although it is riddled with faults, they are merely local ones, and have no connection, I imagine, with those of the Steam-measures, which lie several hundred yards lower, the Middle or Pennant Measures intervening. These main or big faults running down the valleys have formed, or at all events influenced, the drainage lines, and have thus given a decided groove for denudation to work upon afterwards. The depression running at right angles across the field appears, with great probability, to be connected with the great saddle or anticlinal which commences in Monmouthshire at Newbridge (a little below Crumlin), and runs across the basin to the Rhondda Valley, thence to Maesteg in the Llynvi Valley, finally dying out at Llanelly in Caermarthenshire; having the effect, as Sir Henry De la Beche has shown, of bringing the Lower Measures, which should be at their deepest, to the surface, and thus enabling the coals to be easily won at Maesteg, where a large ironwork town has arisen in consequence.

The presence of this anticlinal is manifested by the appearance of the Cockshot-rock (although it is not known in Monmouthshire under that name); a white quartzose sandstone, which has evidently been altered and thrown up in connection with the anticlinal and the disturbed superficial cross valleys that I have named, and at the same time, I imagine, as when all the parallel north and south valleys were formed; and this was the principal event in the geological history of the Coal-field, which we may therefore suppose to be summed up as follows:—

1. The deposition of the coal-beds, with all their attendant clays, shales, and sandstones.

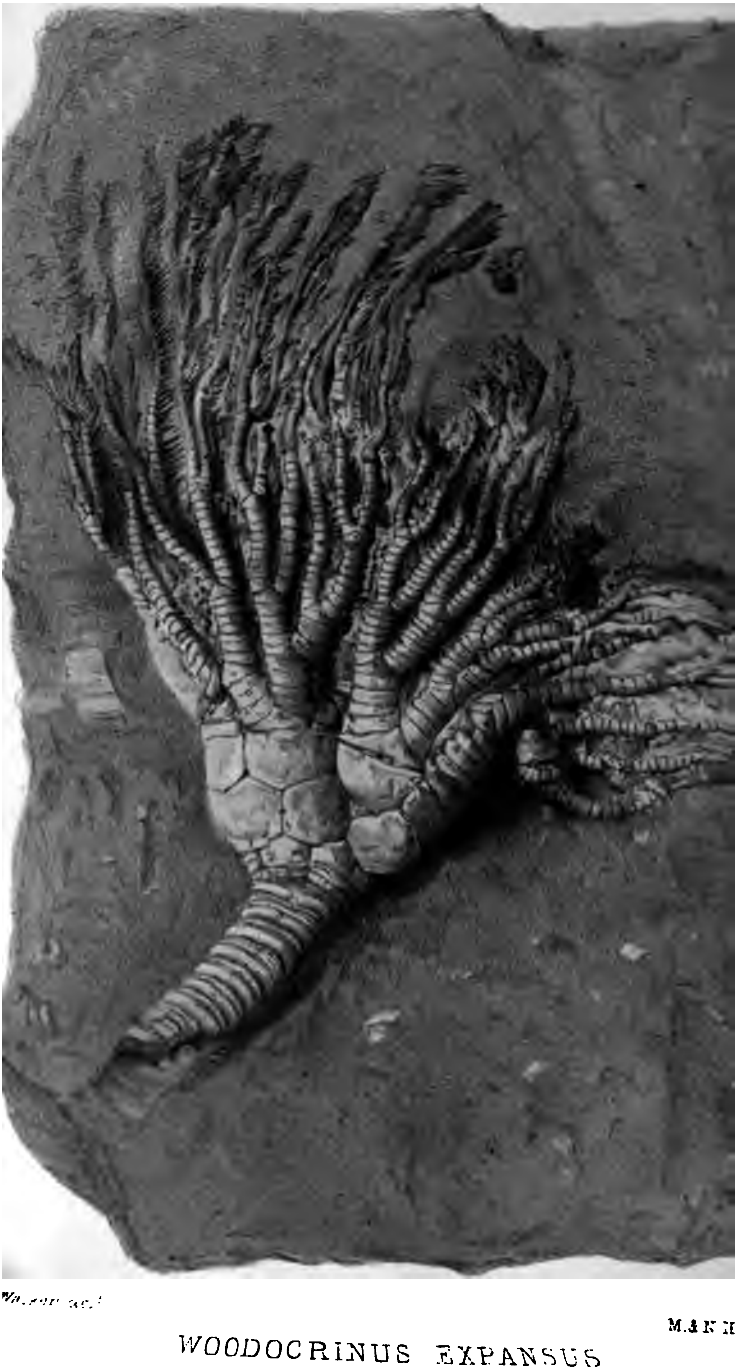
2. The repeated subsidence of the strata thus formed, so as to allow a repetition of the process.

3. The occurrence of the grand force which gave the change to the Measures already formed, and the outline of the topographical features.

4. The deposition of the Upper Measures.

5. The gradual elevation of the Coal-field by slow and successive stages,—the proof of this being seen in the uniformity of height and outline, and the occurrence of terrace-beaches in the Pennant Hills, each terrace marking a period of rest.

6. The denudation which has carried off on the east nearly all the Upper Measures, and over the whole of the basin, has left them in a fragmentary condition. From the discovery by Sir W. Logan of coal-pebbles and detritus in Carboniferous beds of evidently more recent formation, it is not likely that denudation has been limited to one period; but has taken place at different times. It is easy to conceive how the harder material of the Pennant rocks escaped, while the softer shales of the river-valleys were washed away; each denudation-period contributing to scoop out and deepen the valley, the direction of which had already been given by the great pressure.



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M.& N. H

WOODOCRINUS EXPANSUS

I have only attempted to give an outline of the thoughts which have so often struck me when geologizing in the South Welsh Coal-field, and which, while adding to the interest of the more minute details, really form the framework on which the details depend.

VII. GEOLOGICAL NOTES ON THE MOUNTAIN-LIMESTONE OF YORKSHIRE.

By G. E. ROBERTS, Esq., F.G.S., &c.

[Plate V.]

PROBABLY few geologists pass through Yorkshire *en route* for the North without paying a visit to the large and most interesting museum illustrative of local, as well as of general, British Geology, formed by Mr. Edward Wood, F.G.S., of Richmond. The joint papers by Prof. L. de Koninck (of Liége) and Mr. Wood on the new and remarkable genus of Crinoids, named by De Koninck *Woodocrinus*, in honour of their enterprising discoverer, which appeared in the 'Geologist'* and other scientific journals, have given the genus an important standing among *Crinoidea*; but since that publication of the material acquired by Mr. Wood he has been so fortunate as to add extensively to his fine collection, chiefly through the kindness of his friend and neighbour Mr. Brown, J.P., who opened quarries on his estate at Holwith for the sole purpose of aiding the researches of Mr. Wood; and the wall-cases in the museum devoted to these fine Crinoids now present a wonderful richness of fossil-wealth. Amongst many other fine specimens I would chiefly notice the exceedingly beautiful specimen of *Woodocrinus expansus*, which is not only, beyond doubt, the finest ever found, but has a peculiar interest from the fact of its retaining, in a purple-coloured suffusion on the tips of some of the rays, which, with their attendant fringe of pinnules, terminate the arms, some indication of the animal substance which clothed them. This colour is probably due to a phosphate of manganese. As this specimen is thus doubly interesting, I am much indebted to Mr. Wood for permission to have it figured in illustration of my remarks.

It may be useful to remark that six species of *Woodocrinus* have been determined from Mr. Wood's collection, together with the following genera and species from the same Mountain-limestone locality:—*Hydreionocrinus Woodianus*, De Koninck, described in 'Bulletin Acad. Roy. Bruxelles,' and in the 'Geologist,' vol. i. p. 146; *Cheirocrinus Koninckii*, MS. Salter, and *C. flagellum*, MS. Salter; together with new undescribed species of the genera *Mispilocrinus*, *Platycrinus*, and *Poteriocrinus*.

It is necessary to observe that the figure given in the 'Geologist' for January 1858 (vol. i. pl. 2) of *Woodocrinus expansus* was a restoration from an imperfect specimen, which merely gave indications of the column, and was very imperfect in its pelvic plates.

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* Vol. i. p. 12

The figure now given of the species may be therefore considered as representative.

While staying with Mr. Wood, I had an agreeable excursion to the lead-mines of Old Gang, in the higher and wilder parts of Swale-Dale, being guided over this really wonderful district by its proprietor, Sir George W. Denys, Bart. The excessively steep and rugged combs which characterize this dale afford some exceedingly fine geological sections in the Mountain-limestone series, but are so trying to the *physique*, that I must be pardoned if I brought away few notes beyond a general sense of the remarkable characters of the lead-bearing rocks. Galena is the ore worked, in lodes of very variable richness. The distance of the mines from any railway, and the necessary expenses of cartage, are against them; else I scarcely know a lead-bearing district in England which might compete with this, were the veins fully explored, and were there such facilities of carriage for the ore (or smelted metal) as a railway passing the district would give.

Much has been said about the occurrence of copper in the Mountain-limestones of the North Riding. I fear that any copper-ores worked within the acknowledged geological limits of these rocks, will bring but little of the nobler metal to the pockets of their owners; but as an amateur mineralogist, I was greatly interested in a splendid specimen of chrysocolla, of very pure quality, obtained shortly before my visit by Sir G. W. Denys from his mines at Roughten Gill, Calbeck. It more nearly resembled in colour and lustre the chrysocolla of Siberia than that of Cornwall.

ABSTRACTS OF FOREIGN MEMOIRS.

MINERAL WATERS CONSIDERED IN THEIR RELATIONS WITH CHEMISTRY AND GEOLOGY.

LES EAUX MINÉRALES, ETC. Par H. LECOQ.—(*Continued from page* 116.)

The temperature of mineral waters varies extremely. Some are cold,—probably (according to M. Lecoq) cooled in rising; most of them are warm. Some are boiling, bursting out at the bottom of the sea, and bubbling up at the surface. At a small depth below the earth's surface the temperature of some thermal springs is far above the boiling-point of water. The Auvergne springs do not rise above 82° C. (180° F.), but they are believed by M. Lecoq to have been higher when the volcanos were active. In the Pyrenees the hottest springs do not exceed 78° C. (172½° F.). M. Daubrée has estimated the quantity of heat emitted by 45 French springs, whose volume is approximately known, as sufficient to melt a film of ice, at the temperature of 0° C. (32° F.), having a thickness of $0^{\mathrm{m}}{\cdot}00000324$ (·0001275 inch.). This is certainly a very small quantity, but M. Lecoq speculates on the much greater influence of hot springs during earlier geological periods.

The contents of mineral waters vary also both in nature and quantity. Some contain hardly any appreciable residue, others more than 100 grammes a litre (nearly 20 ounces a gallon). By chemical investigation, and above all by spectral analysis, they have already been found to contain all the metalloid elements except selenium and tellurium, and 21 of the metallic elements. The quantity of solid matter brought to the surface by the mineral springs of the central plateau of France in one year is upwards of 8,000 tons.

Of the gases contained in mineral waters, two (oxygen and hydrogen) are the constituents of water. Both are common; but neither of them occurs in a simple state. Nitrogen is also very common. M. Lecoq is inclined to refer the origin of these to the distant epoch when, as he believes, the springs were much more abundant than they now are. Ammonia and carbonic acid are both present, separately and combined. Sulphur and sulphurous acid, often combined with hydrogen, are also common. These sulphurous combinations are believed to have an organic origin, but they are referred, as usual, by our author to his great subterranean laboratories beneath the zone of primitive rocks, where, as he believes, the water is mineralized.

Tellurium, chlorine, iodine, chromium, fluorine, phosphorus and arsenic, either native or in combination, are next specified, and examples of their presence given. Most of them are common. Boron (boracic acid) is also familiar; and silicon is universal. The phenomena accompanying the presence and deposit of silica are carefully described, and the same remark applies to carbon and carbonic acid. Most of the facts have been previously recorded; but they are here conveniently grouped, and the theoretical views of the author are again brought in. He believes that the first important (?) introduction of carbonic acid dates from the deposit of the Carboniferous Limestone (p. 123). The term *grauwacké*, now almost extinct, serves to include the whole of the vast Devonian, Silurian, and Laurentian series; and in these limestones are practically ignored by our author. In a subsequent chapter bitumens are considered. With these and other hydro-carbons, M. Lecoq seems chiefly familiar so far as his own district of Central France is concerned; but he gives an outline-account of the discovery of oil-wells in America, and their development up to 1861.* Like other substances rising from the earth in springs, bitumens are here referred, not to an organic source, but to the great depths of the earth for their origin.

Potassium, lithium, rubidium, cæsium, thallium, glucina, have all been obtained either from mineral waters, or from positions that render their presence in such waters almost certain. Potassium is very common; the others, until lately, were rare or unknown. Lithium is now very generally recognized by the aid of spectrum-analysis Many of the salts of sodium, besides the chloride (common salt), are met with. They are among the substances most generally distributed in water, both on and beneath the surface. The carbonate, nitrate, and sulphate of soda are those chiefly noticed. The circumstances under which rock-salt and various combinations of salt are found are carefully described (ch. xiii.). Emanations from the interior of the earth (whatever and wherever that may be) are believed to be the sources of salt as well as of other contents of springs. In another chapter M. Lecoq expresses his belief that the sea was originally fresh, and has become salter as time advanced.

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* The exports from American ports now amount to about twenty million gallons annually.

The salts of lime and magnesia naturally occupy a considerable space in any account of mineral waters and their operations. They are universally distributed, and in various forms. We do not, however, observe anything of novelty in reference to this subject. The salts of aluminium are also found in water; and as these are largely deposited in various forms, often very complex, wherever hot water has passed, they admit of very interesting exemplification. The work done by Deville, Daubrée, and other chemists, is quoted; and the subject, which is one of great interest, is treated in reference to mineral veins.

Of the metals proper, a considerable number are found in mineral springs. M. Lecoq quotes several localities where salts of manganese occur; and iron is well known to be almost universal. Cobalt and nickel have been found at Boulou. Zinc and cadmium are probably present in mineral waters near deposits of calamine; and the same may be said of chromium. Molybdenum, tungsten, and vanadium are not rare; and antimony is occasional. Tin, titanium, copper, lead, silver and gold, have all been detected in water; and some of them are common in thermal springs.

Organic matter has been found in mineral waters: it has been recognized under various names—*barrègine*, *glairine*, &c.; its properties being different from different springs. M. Lecoq finds in this substance additional evidence in favour of his view that mineral waters proceed from beneath all stratified and other rocks forming the crust of the earth; for he regards these organic bodies as remains of the earliest forms of life introduced upon the globe. According to M. Filhol, who has examined these substances, they are most abundant in the hottest springs. A spring at Arles is estimated to yield 754 kilo. (1,663 lbs.) a day of organic matter; another at Thuies 2,800 kilo., 6,176 lbs. (55 cwt.) a day. These results cannot be altogether depended on. The source of this organic matter is by no means clear; and the phenomenon is one of extreme interest.

Mineral springs are not without changes. Their temperature, although generally constant, is subject to modification; for some have increased, some have diminished, within the limits of observation. Earthquakes have not unfrequently affected hot springs. The volume of water delivered also changes in some cases with alterations of the pressure of the atmosphere, and more frequently or markedly by earthquakes. Periods of long intermission in the running of such springs are not unknown; and alterations in the mineral contents have been observed in some very remarkable cases.

That mineral waters produce very important results on the rocks they traverse, has long been known. They often disintegrate, and sometimes decompose, even porphyries and granite; they change jaspers into earthy minerals of very different appearance, and silicify wood and other organic bodies. In the same way, water has certainly produced very considerable and special deposits in mineral veins, being indeed the chief agent in their metamorphism. There can be no doubt that water has had much to do in all phenomena connected with the deposit of minerals in crevices and veins.

Distinct relations may often be traced between mineral springs and volcanic disturbances; and M. Lecoq sees in this something to confirm him in his view, often expressed, that lavas proceed from below all metamorphic rocks, including granites. In finally treating of the origin of mineral springs, he recapitulates some of the principal points alluded to in the early chapters of his book, and quotes M. Pissis and his observations on the Andes as confirming the views he has expressed concerning the Auvergne district. He concludes with a brief *résumé* of his arguments. We must leave our readers to examine these for themselves, if they are inclined to do so. The book is interesting, though much of the matter has already appeared; and the theory, if not original, is pertinaciously advocated. There is no doubt, however, that a careful and exact study and record of the main facts concerning important groups of mineral springs would be very valuable, both immediately and as a standard of comparison hereafter. Such a record is commenced in France, and should be made in other countries also.—D. T. A.

REVIEWS.

Elements of Geology; or, the Ancient Changes of the Earth and its Inhabitants, as illustrated by Geological Monuments. By Sir Charles Lyell, Bart., F.R.S., &c. Sixth Edition, greatly enlarged, and illustrated with 770 Woodcuts. 8vo. pp. 794 London: Murray. 1865.

THE first edition of this work was an expanded form of one of the chapters of the author's 'Principles,' and was termed the 'Elements of Geology;' it subsequently, in several editions, was enlarged more and more as the 'Manual;' and now, having absorbed the several Supplements published since its Fifth Edition in 1855, it again comes before us as the 'Elements,' carefully elaborated by its distinguished, experienced, and enthusiastic author, especially in his own lines of research. We do not see much alteration in the first nine chapters; but the 'Tabular View of the Fossiliferous Strata,' pp. 102–106, has been re-planned, with some improvements. Chapters x.–xiii., which follow, treating of 'Recent and Post-Pliocene Periods,' and including Fossil Man and the Antiquity of the Human Race, Lake-dwellings, History of Caves, Glacial Conditions, and all the interesting facts and questions thereto belonging, are re-written, and full of valuable material, which the author has collected with care and judgment, and conscientiously verified by personal research. In his well-known 'Geological Evidences of the Antiquity of Man' (in three editions, with Appendices) Sir C. Lyell, of course, treats far more fully of these very interesting and difficult subjects; and that work is freely referred to in the 'Elements.' As the origin of some lakes is now a question among Geologists and Glacialists, we particularly recommend the former to study Lyell's suggestive explanation of the conversion of valleys, here and there, into lakes during and in consequence of the oscillations of level that mountain-sides and the lower country must have suffered (pp. 168, &c.). The Tertiary Beds, ever a favourite study with the author, have three chapters and much consideration, especially as regards the Fossil Plants of the Miocene Beds of Switzerland, those of Œningen in particular, as worked out so abundantly by O. Heer in his 'Flora Tert. Helvetiæ,' &c.; and Sir Charles argues that probably too great a distinction between Miocene and Recent Plants and Insects has been made, since there is a greater proportional resemblance between Miocene Molluscs and those of recent times; Conchologists having determined one-third of the Upper Miocene Shells as still living, whilst all the Plants and Insects are regarded as being extinct. What Botanists have done and can do for Geology is shown in the account of the 'Miocene Atlantis' (pp. 265, &c.).

In the account of the Secondary Formation (Chapters xvii.–xxii.) we have, as additions and improvements, some new Fossils,—some statistics of the Jurassic Fossils (after Etheridge),—renewed and forcible arguments as to the *marine* denudation of the Wealden area, —some remarks on the Triassic Rocks as classified by the Geologists of Austria and Bavaria,—the Triassic relationship of the Coal-fields of Eastern Virginia and of the 'Dolomitic Conglomerate' of the West of England. We miss, however, the valuable inferences that have been drawn by Godwin-Austen from the presence of drifted coal and granite in the Chalk; and we protest against the less general though British term 'Penarth Beds' (see also the Table at p. 104) being substituted for the well-chosen 'Rhætic,' and especially against the latter being referred to Mr. Charles Moore (who judiciously adopted it) instead of to Gümbel (p. 439). In several respects, we remark that this Chapter xxii. (on the Trias) is one of the least satisfactory of the improved portions of the 'Elements.'

Chapter xxiii., on the Permian Beds, we must pass over. Like the Sleeping Beauty in the Wood, here it remains as formerly, waiting the loving touch that is to vivify it, in the next edition perhaps, and give it the warmth and fullness of which it is capable. The many cuts in its few pages look like jewels bestowed where there is no love; a revised and fuller text would be a better setting for them, and more worthy of Permia, whose dominion, wide as it was, has lately been enlarged.

The important additions to our knowledge of the Fauna of the Carboniferous Period, due to Dr. Dawson and Sir Charles himself, are necessarily prominent in Chapter xxv.; as also the remarkable series of Professor Huxley's new Coal Reptiles, *Loxomma*, *Pholidogaster*, and *Anthracosaurus*, together with Mr. Marsh's *Eosaurus*, all Labyrinthodonts. The 'Devonian' Chapter has been enriched with home and foreign matter, especially as regards Professor Huxley's 'Old Red Fishes,' and Dr. Dawson's remarkable and important new plant the *Psilophyton*, which characterizes 'Devonian' underclays throughout great areas in Canadian North America. The *Telerpeton* and other Reptiles of the Elgin Sandstones are banished by Sir Charles (on good grounds, we think) from the Devonian list. Silurian and Cambrian rocks and fossils have a careful exposition in Chap. xxvii., the Cambrian group being made to comprise the Tremadoc Slates, Lingula-flags, Harlech Grits, and Llanberis Slates: the Huronian and Laurentian rocks are also noticed, the last being newly of interest on account of its Eozoan marble, lately discovered by the State-geologists of Canada; but the great extent of the Laurentian in Europe and the British Isles is hardly alluded to.

The Chapters on Volcanoes and Volcanic Rocks have again profited by the results of the author's repeated visits to this, one of his most favourite fields of labour; and in the working out of the age (Upper Miocene) of the igneous outbursts of the Canaries, Madeira, and the Azores, we see how Geologists can help each other, the good results of co-operative science, and the happy application of the labours of at least eight naturalists and geologists to the geological history of this important volcanic area. In treating of 'Metamorphism,' to which indeed Sir Charles long ago gave distinctness as a special condition of rocks, he has not forgotten to give weight to the 'hydro-thermal' notions advanced of late years, but warns us against accepting them too freely. Plutonic rocks, cleavage, and mineral veins are also treated of in connection with this part of the subject; and we may remark that the structure of the Isle of Arran, remodelled after Dr. Bryce's latest researches, is made to illustrate the relative ages of certain fossiliferous, volcanic, plutonic, and metamorphic rocks, still more clearly than heretofore.

The 'Elements' is a systematized exposition of the strata and other rocks, worked out with special reference to Organic Remains: the probable inferences, however, as to the old lands and seas, that may be drawn from the organic remains, and from the several deposits imbedding them, are rather left to the student than offered by the writer; and the disentanglement of the complicated, overlapping, shifted, folded, and altered strata, in every formation, are left in great part to the practical explorer and to special works on the subject. Yet the student has in Lyell such a trustworthy, intelligent, and philosophic guide, full of old lore and rich with modern facts, that he must welcome him heartily, and eagerly follow him among the relics of the past, and in studying to good advantage the geological monuments of the ancient changes of the earth and its inhabitants.

BIOGRAPHICAL NOTICE OF THE REV. DAVID URE, WITH AN EXAMINATION, CRITICAL AND DETAILED, OF HIS HISTORY OF RUTHERGLEN AND EAST KILBRIDE. By JOHN GRAY, Memb. Phil. Soc. Glasgow. 8vo. Glasgow: 1855. Pp. 59.

UNDER the above title we have a brief life-sketch of a Scottish geologist and naturalist of the seventeenth century. David

Ure, like many of his countrymen of note, had his position to make in the world. He was an operative weaver, as was his father before him,—and just as Hugh Miller was a stonemason. But, like the latter, he had a strong thirst for other knowledge than that of his profession. He sought and obtained a good education. He was schoolmaster a while. Then he procured licence to preach, and became assistant to the minister at Kilbride, with a salary of ten pounds a year and his maintenance. While thus situated he had, or made, opportunities for gratifying his love for natural history. He worked hard at the geology of his parish and that of Rutherglen. He investigated after a fashion that was somewhat novel in those days; for it was then customary to write about the earth and its origin without examining it. But David Ure went grubbing and poking about among the rocks exposed on the hills and in the glens of Western Scotland, collecting fossils and facts relating to physical geology—thereby seeing things as they were, and not as they might or ought to have been. The result of these investigations he published in the work by which he is now so well known,—'The History of Rutherglen and East Kilbride.'

There must have been something decidedly practical in the appearance of Ure during his field-workings. Short of stature and a hard walker, he could withstand almost any amount of fatigue. A great-coat, with one large pocket for specimens and another for bread and cheese, usually accompanied him. A bit of sward beside a spring as usually formed his dining-place; though on rare occasions, when he felt inclined, or could afford to dissipate, he would eat his cheese and bread in the kitchen of some village ale-house. Along with him he carried a tin-box for stowing plants; a large cudgel, armed with steel, so as to serve both as spade and pickaxe; a few small chisels and other tools; a blowpipe, with its appurtenances; a small chemical apparatus, optical instruments, &c. His friends called him a walking-laboratory; and certainly he must have looked rather like something of the sort when so accoutred.

In 1796, Lord Buchan presented him with a living in Linlithgowshire. Two years afterwards he died.

Ure's 'History of Rutherglen and East Kilbride' describes the antiquities as well as the natural history of these parishes. Eleven of the plates are devoted to illustrating the Carboniferous fossils which he had collected; and these are so carefully delineated as to be easily identified by modern palæontologists. From the illustrations it is evident that Ure knew and figured between eighty and ninety species of Carboniferous vegetable and animal fossils, which have been since rediscovered and named after the Linnean method by other authors. Among the fossils figured are some species of bivalve Entomostraca, the minuteness of which shows that Ure observed small things as well as great. It is only within the last few years that attention has been again drawn to these interesting though minute fossils; more than thirty species of which have been lately discovered in the Carboniferous strata of the West of Scotland, by those who are worthy successors of David Ure in the work of geological research. The work before us gives the accepted names of the fossils figured and described by Ure.

ON THE GEOLOGICAL STRUCTURE OF PARTS OF THE DISTRICTS OF SALEM, TRICHINOPOLY, TANJORE, AND SOUTH ARCOT, IN MADRAS PRESIDENCY (BEING THE AREA INCLUDED IN SHEET 79 OF THE INDIAN ATLAS). By W. KING, Jun., and R. BRUCE FOOTE, of the Geological Survey of India. 8vo. 1864. WILLIAMS and NORGATE, London.

THIS is the second part of the fourth volume of the 'Memoirs of the Geological Survey of India,' published under the superintendence of Dr. Oldham, who has presided over the Indian Survey since its commencement, and is ably assisted by several gentlemen sent out from this country, most of whom have received their scientific training in the School of Mining in London and Dublin. As in this country, the Geological Survey of India is preceded by the Trigonometrical, which forms the basis of it. The scale upon which the maps are published is 4 miles to 1 inch, and each sheet of the Indian Atlas represents an area of more than 14,500 square miles.

The tract described is bounded on the east by the Bay of Bengal, and stretches into the high regions of the Eastern Ghauts (or 'Ghats,' as it is written by the authors), which send off several spurs towards the south of considerable altitude, the highest being the Shevaroys (Shervaroyenmullay), north of the town of Salem. This is a very noble range of mountains, attaining an elevation of 5,260 feet, or thereabouts, above the sea-level, and is bisected by a deep ravine into two great limbs, between which flows the Vaniar River, draining the greater portion of the range, and pouring its waters into the Punniar. On the north-east side of this range the scenery is described as being exceedingly grand, owing to the precipices of naked rock rising from the ground to heights exceeding a thousand feet; on the opposite side of the Shevaroys, however, there are no very striking features.

Bordering the mountainous region, and forming an intermediate belt between it and the low country along the coast, is the Baramahal Plateau, which rises up gradually from north to south, that is to say from the valley of the Punniar River to the foot of the Shevaroys and the Darmapoor Ranges. The southern part of this table-land is generally a barren, stony plain; the part next the hills is more fruitful, owing to the greater depth of soil. The table-land slopes to the east, and at the Chungama Pass joins the Payen Ghat, or low country proper. Strictly speaking, it would appear that the mountain-range of the eastern Ghauts is itself an ancient table-land, out of which the valleys have been scooped, either by marine denudation or atmospheric wasting, or both; for, when viewed at a distance from the low country, the ridges appear to rise to a certain elevation, corresponding to an imaginary plain sloping to the eastward, and no higher; we are probably little aware to how large an extent this phenomenon characterizes the mountain-ranges of the globe. Those of South Wales, Norway, Central France, and the Rhine, are illustrations nearer home.

The third region of the Payen Ghat is a general level, but little elevated above the sea, and only broken here and there by a few low hills, or rocky projections, and scarps formed of the Cuddalore series of strata. Between the Payen Ghat and the sea, are the immense alluvial flats formed by the deltas of the Cauvery, the Punniar, and Guddelom, and other rivers, and which are fringed by dunes of blown sand, lining the monotonous coast of this part of India.

The general geological structure of the district is simple, and has been laid down (though not very correctly) on Greenough's Geological Map of India. The greater portion of the interior, including the mountain-ranges, is composed of metamorphic rocks, such as gneiss, hornblendic and talcose schists, thrown into several great, and many lesser, folds, and traversed by dykes of granite and trap. Resting upon this formation, which is of great, but unascertainable, thickness, are a series of Cretaceous beds, described in the former part of vol. iv., by Mr. H. F. Blanford. Next comes 'the Cuddalore group,' composed of soft sandstone and laterite, described as 'a highly ferruginous conglomeratic deposit of indurated clay,'—a very peculiar formation, as its description imports. This series, as it has yielded no fossils except the stems of trees, is of indeterminate age. It occupies four distinct areas, separated by the valleys of the Punniar, Vellaur, and Cauvery Rivers, and extends to the margin of the alluvium. The alluvium itself is partly of fluviatile, partly of marine origin, as proved by the occurrence of beds of sea-shells in several places inland, especially at the village of Kandyamaller, at the southern extremity of the great Permalyeri tank. The species here found are identical with those inhabiting the neighbouring coast, and prove that the elevation of this tract is of comparatively recent date.

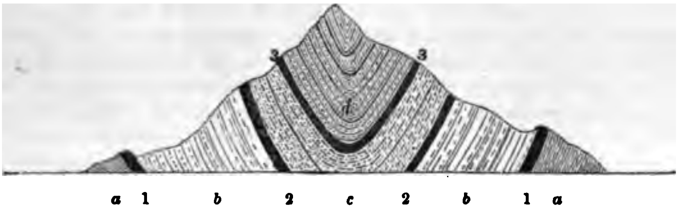
The tendency of the granitoid rocks to weather into tors and isolated bosses, which in a glacier-region might be considered as the work of ice, is worthy of attention, as showing how nature often employs different agents to bring about apparently similar results. These huge masses are common in many parts, towering amidst the surrounding jungle, or seated, like perched blocks, on bosses of rock rising above the ground. One of these, of which a sketch is given, occurs in the midst of the scrub-jungle near Malayanur. 'Seen from the east or west sides, this splendid tor has a rudely pyramidal shape ; but, when looked at from the north or south, it rises up like a fine tall tower, and may be seen three or four miles off, standing up boldly from the surrounding jungle. In height it cannot be less than 50 to 55 feet.' The present form of these tors and blocks is due to weathering ; but it is in the highest degree probable, if not absolutely certain, that the original blocks date as far back as the period of that great denudation which has acted so powerfully over this region, sweeping away large portions of the metamorphic, Cretaceous, and Post-Cretaceous formations. We can conceive that, during the retreat of the ocean, isolated blocks and small islands of rock would be left standing out at intervals above the surface, which the rains, the atmosphere, and the disintegration of the rock would work into forms of the grotesque and fanciful aspect we now find them.

The great beds of magnetic iron-ore (or magnetite) form an interesting feature in the mineral structure of this region. They are found in the metamorphic series, apparently stratified with the other beds, and with them thrown into folds, or dipping at high angles, and occurring at intervals, not only in the district here described, but far to the northwards, in the same group of azoic rocks. The principal beds belong to four groups :—

1st. The Godamullay group, east and north-east of Salem.
2nd. The Tullamullay-Kolymullay group.
3rd. The Singiputty group.
4th. The Tirtamullay group.

We must refer the reader to the memoir itself for an account of these wonderful masses of iron-ore, which in quantity are beyond all calculation, forming mountain-ridges, and rising into vertical precipices of hundreds of feet in height. The iron to be obtained from these deposits is, no doubt, of the very best description, as it is identical with that of Arendal in Norway, and the mines of Sweden. The ores, however, of Madras labour under the serious disadvantage of being situated far from fuel, the charcoal used by the natives and one company of manufacturers being scarce, owing to the wasteful manner in which the jungles are destroyed by the natives. At the Porto Novo Company's works, at Beypoor, 13½ tons of charcoal are stated to be consumed for every ton of pig-iron, which to us seems an enormous proportion, and must render the production of iron very costly.

The manner in which the beds of magnetic iron occur at Kunjamullay, near Salem, close to the Madras and Beypoor Railway, will serve to illustrate the general features of these deposits. Kunjamullay is a fine isolated mountain, rising 1,000 feet above the surrounding plain, and 2,000 feet above the level of the sea. The structure of this mountain is that of a trough, in plan an ellipse, lying with its major axis nearly east and west. Around this ridge



Section of Kunjamullay.

a. Gneiss with garnets, &c.
b. Gneiss, talcose-schist and quartzo-felspathic beds, &c.
c. Quartzo-hornblendic beds.
d. Quartzo-hornblendic beds full of large garnets, and of great thickness, forming the summit of the ridge.

1. Iron-bed
2. Iron-bed
3. Iron-bed.

the several beds of magnetite crop out, dipping with remarkable regularity towards the axis of the trough, and interstratified with various beds of gneiss, as shown in the annexed section, drawn across the summit and at right angles to the axis of the ellipse: this structure is a modification of one of the great folds of the gneissic region before alluded to.*

There are three principal beds of ore, of whose continuity all through and around the trough there can be no doubt, but their outcrop is often observed by accumulations of talus and blocks of ore. Two other beds appear in the summit of the ridge ; but, owing to the talus, and the thick and thorny scrub, they could not be well traced out. The two lower beds are described as exceedingly conspicuous, even when seen from a great distance, especially in the morning-light, when they may be seen standing out along the flanks of the ridge in dark, sharply sculptured terraces. These beds are each 50 feet in thickness, and those higher up the hill about 20 feet or less. Vast quantities of the ore are strewn along the flanks of the mountain, and over the plain for a distance of one or two miles from the base, and require merely to be collected for smelting. Limestone, for a flux, occurs in the neighbourhood ; but, considering the scarcity of fuel, it is probable that British iron will be able, for a long time to come, to compete with the native produce in the Indian markets.

RESEARCHES INTO THE EARLY HISTORY OF MANKIND AND THE DEVELOPMENT OF CIVILIZATION. BY E. B. TYLOR. London: J. MURRAY. 8vo. 1865.

WE are much indebted to Mr. Tylor for this contribution to an important branch of literature. Thanks to the moderation of the author's views, and the propriety of his style, the work is free from those objections which exclude almost every book on 'Anthropology' from the household library.

Not many years ago, the Geological Record was supposed to terminate with the appearance of Man upon the globe. His advent marked the division between the former world and that which is the domain of the recent naturalist. That boundary-line has receded with the progress of record, and become so shadowy, that although we hear of a 'Quaternary System' and 'Post-Tertiary' deposits, it would be difficult to define or give a satisfactory reason for distinctions of so little value. If the 'Miocene' is to include all deposits with 50 to 100 per cent. of extinct species, surely the 'Pliocene' will suffice for those with from 1 to 50 per cent., whether they be in St. Helena, where nearly all the land-snails have become extinct; or in Denmark, where the bones of the great Auk alone remain to testify of its recent existence.

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* A similar association of iron-ore with argillaceous, siliceous, micaceous, and talcose schists, has been described by Herr E. Stöhr (N. Jahrb. 1864) as noticeable in Singhbhum, south-west of Bengal; and, in company with *emery*, by Dr. Jackson, in Massachusetts (Silliman's Journ., No. 115, Jan.).—EDIT.

The Pyrenean Caves have given up the bones of a people, their inhabitants, who subsisted on herds of Reindeer, and were probably not more civilized than the Samoyedes or Laplanders; while the gravel of the Somme has yielded the rudest forms of flint weapons that can be relied on as artificial, and which may have belonged to a still more ancient race, coeval with the Mammoth and the Siberian Rhinoceros.

Looking, then, upon man as a *species* occurring in a fossil state, we are legitimately bound to study the earliest historic records of his geographical distribution, and the condition of his primitive life. The result of these inquiries is nearly always the same. Every country shelters, in some remote mountain or secluded shore, the remains of an older race than that which now dominates it, as Latham has well shown. The Kymri who were driven by many successive invaders to the more hilly and barren regions of these islands, were themselves emigrants from the far East, and have left indications of their route in circles of stones. They appear to have entirely extirpated the 'short-headed' people, their predecessors, who were such successful miners, and traded with the Phœnicians in their 'ships of Tarshish.' South of us, the Basques still remain, the reliques of this race; and in the North, the Laplanders still retain much of their primitive habits, and the taste for metallurgy. From this country they wholly passed away, after bringing to perfection the art of making stone implements, and inaugurating an age of bronze.

The evidence collected by Mr. Tylor respecting the condition of early and uncivilized tribes is very full and comprehensive. It goes to show that progress has been the general law; although some races have deteriorated after emigrating into less favoured regions, and those nations have declined whose civilization was based on conditions incompatible with the general advancement of society.

However worthless the once-accepted doctrine that India was the cradle of the human race—because, being the highest portion of the solid world, it was the first to emerge from the sea, and become habitable,—there is something more in the argument of our Indian geologists, that a country which has never been submerged since the Middle Tertiary Age would be the most likely to afford evidence of man's early history. The most ancient indications found in Europe will probably fall far short of his real epoch. The oldest inhabitants of Europe, the Lapps, are a dark people; but it is a curious and significant fact, that the most primitive races of the East are not merely dark, but black; and while there is no difficulty in understanding how the black races have become superseded by those with lighter skins, there are physiological reasons which render it most unlikely that the blacks were derived from a brown or blonde people.

The author has amusingly suggested that some of our modern customs are only intelligible in the light of early history; such as the piercing of the ears for jewellery, and the barbaric accoutrements of our cavalry. The brazen horseshoes that ornament our dray-horses were originally crescents, and represent the 'little moons' worn by the camels of the Midianites three thousand years ago. Those who have adopted similar views to Mr. Darwin will carry this argument farther, and doubtless find in it the explanation of many other things that have puzzled philosophers in all ages to account for. Man is an animal still; and the gradual subjugation of the old brute nature beneath the influence of the spirit of goodness may surely be traced, not only in the general history of mankind, but in the life of every individual who 'battles for the true and just.'

REPORTS AND PROCEEDINGS.

GEOLOGICAL SOCIETY OF LONDON.—I. Feb. 22, 1865.—W. J. Hamilton, Esq., President, in the chair. The following communications were read:—1. 'On the Lower Silurian Rocks of the South-East of Cumberland, and the North-East of Westmoreland.' By Professor R. Harkness, F.R.S., F.G.S. (See also GEOL. MAG., Vol. I. p. 287.) The district described in this paper consists of a narrow band of country on the western side of the Pennine Chain; it possesses external features which indicate a geological structure different from that of the Pennine escarpment, and from that of the adjacent country on the west, from which it is separated by the Pennine fault. Prof. Harkness described the Lower Silurian rocks occupying this narrow tract in some detail, and showed them to consist of Skiddaw Slates, with interstratified greenstone, porphyry, and ash, and a band of fossiliferous shale. He also gave, in illustration of the structure of the country, a section from Melmerley Scar to Romanfell, and one from Milburn to Dunfell, together with a geological sketch-map of the narrow Lower Silurian tract in question. In conclusion, the author described a fault which brings the Skiddaw Slates against the Coniston Limestone, and another, which cuts through the Lower Silurian rocks of the district, having a course at right angles to the former, and nearly parallel to that of the Great Pennine fault.

2. 'Note on the Volcanic Tufa of Latacunga, at the foot of Cotopaxi; and on the Cangáua, or Volcanic Mud, of the Quitenian Andes.' By R. Spruce, Esq. Communicated by Sir R. I. Murchison, K.C.B., F.R.S. The Volcanic Tufa described in this paper is not only used for building-purposes, but also by the smiths instead of charcoal, as when heated to redness it emits considerable heat, but very little flame. The author then described the large deposits of Volcanic Mud, called Cangáua, which are met with throughout the central valley of the Quitenian Andes. This mud is compact, slightly argillaceous, and more or less saline, and occurs in rock-like masses, yielding very slowly to atmospheric agency, or even to running water.

3. 'On the Discovery of Flint Implements in the Drift at Milford Hill, Salisbury.' By Dr. H. P. Blackmore. Communicated by John Evans, Esq., F.R.S., F.G.S.—Since the discovery of Flint Implements in the higher-level gravel at Fisherton on the west of Salisbury, a large number of very excellent weapons have been obtained from the drift-gravel of Milford Hill. This deposit is of the same age as the Fisherton beds; but it is situated on the opposite side of the Avon, immediately to the east of Salisbury. Dr. Blackmore described the materials composing the gravel of Milford Hill, and discussed the nature and power of the forces which had brought them together. He then described the position, thickness, and physical relations of the deposit, stating that the gravel is from 10 to 12 feet thick on the top of the hill, becoming thinner and gradually dying away on the sides. The hill itself is quite isolated, being separated from the surrounding higher land by river-valleys; its highest point is about 100 feet above the present level of the rivers. In making a cutting on the south-eastern side of the hill, a bed of sand containing four species of land-shells was discovered near the base of the gravel. No other fossils have been found in the deposit, with the exception of a single tooth of a species of *Equus*. Dr. Blackmore concluded by describing the implements themselves, which nearly all belong to the long-pointed type, thus confirming the opinion of Mr. Evans, that this form is mainly characteristic of the higher-level gravels.

II. March 8, 1865.—W. J. Hamilton, Esq., President, in the chair.—1. 'On the Echinodermata from the South-east Coast of Arabia, and from Bagh on the Nerbudda, India.' By P. Martin Duncan, M.B., Sec. G.S.—Dr. Duncan described eight species of fossil Echinoderms, only one of which was new, from Ras Fartak and Ras Sharwên on the south-east coast of Arabia, and four from Bagh on the Nerbudda. He also mentioned five determinable species of other classes from each locality. Of these fossils, *Hemiaster similis*, D'Orb., and *Pecten quadricostatus*, Sow., were alone common to the two localities; but, with the exception of the new Echinoderm *Cottaldia Carteri* (Duncan), all the species occur in European Cretaceous rocks. He considered the fossils from the two localities to belong to the same period, and discussed the question of the correlation of the deposits containing them with those of Europe, coming to the conclusion that they were most probably of Cenomanian rather than Neocomian age, and of later date than the Pondicherry series: but he also remarked that it is impossible to determine their exact contemporaneity, the vertical range of many of the species being so great, and the parallelism of the allied European Cretaceous beds not exact. In conclusion, Dr. Duncan discussed several questions arising out of a comparison of fossils from distant localities, especially the specific identity of similar specimens occurring in different formations, or in distant regions; also the variability of certain species, and the idea of 'homotaxis.'

2. 'On the Fossil Contents of the Genista Cave at Windmill Hill, Gibraltar.' By George Busk, Esq., F.R.S., F.G.S., and the late

Hugh Falconer, M.D., F.R.S., F.G.S. Communicated by the Secretary of State for War.—This was a letter addressed by the authors to His Excellency the Governor of Gibraltar, General Sir W. J. Codrington, K.C.B., &c., and containing the results of their examination of the Genista Cave. Referring first to Capt. Brome's report for a description of the general features of that cave, the authors stated that the Rock of Gibraltar abounds in both seaboard and inland caverns, the Genista Cave of Windmill Hill being one of the latter class. It is a great perpendicular fissure, and has been traced downwards to a depth of 200 feet; but the external aperture has not yet been discovered. It was full of the remains of quadrupeds and birds, some of the former being now wholly extinct, others extinct in Europe and repelled to distant regions of the African continent (as *Hyæna brunnea* and the *Felidæ*), while others again live now either on the Rock or in the adjoining Spanish Peninsula. It was inferred that there had been a connection by land, either circuitous or direct, between Europe and Africa at no very remote period. The authors observed that the wild animals whose remains were discovered in the cave lived and died upon the Rock during a long series of ages, and they considered the bones were introduced into the cave by rain and streams washing them into gullies and fissures. They also recommended the formation of a local collection of these and other specimens, and urged the appointment of a Geologist to make a geological survey of the Rock, and concluded by expressing their opinion of the value and importance of Capt. Brome's exploration of the Genista Cavern.

Human remains (peculiar in the ridging and flattening of some of the limb-bones, and in other respects), together with polished stone implements, broken querns, pottery, marine shells of edible species, and other objects, were found in the upper chambers, which were possibly used for funeral rites, rather than for habitation, at different times, but not before the Historic Period.

The following species of animals were discovered in the Genista Cave:—

Rhinoceros Etruscus (?)
Rh. leptorhinus.
Equus megarhinus.
Equus sp.
Sus prisca (?)
S. scrofa.
Cervus elaphus, var. Barbarus.
C. dama.
Bos sp.
Bos taurus.[*]
Capra hircus.[*]
C. ægoceros (2 var.)[†]
Lepus timidus.
L. cuniculus.[†]
Mus rattus.
Felis leopardus.
F. pardina.
F. serval.
Hyæna brunnea (and its coprolites).
Canis vulpes.
Meles taxus.
Ursus sp.[‡]
Phocæna communis.
Birds; numerous remains of undetermined genera and species.[†]
Tortoise; species undetermined; rare. Fish; numerous remains, undetermined.[*]

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[*] Abundant in the upper chambers.

[†] Abundant throughout.

[‡] Neither *Rhinoceros tichorhinus, Ursus spelæus,* nor *Hyæna spelæa,* so common in European caves, occurs at Gibraltar.

Elephas antiquus is also found fossil on the Rock, though not in this cave. The Hare, Rabbit, Fox, Badger, and a few Magot Monkeys (probably introduced) are all the wild animals now found on the Rock; and Goats are with difficulty fed there in the hot season.

MANCHESTER GEOLOGICAL SOCIETY.—At the Meeting on February 28th, Mr. A. Knowles presiding, Mr. J. PLANT said that he wished to call the attention of the meeting to *a serious fraud that has been going on for some time among the excavators at the Macclesfield New Cemetery.* The excavations had been made in gravels that belonged to the Drift, and a number of fragments of Shells, and occasionally a few nearly perfect, had been found by the workmen; and these had fallen into the hands of gentlemen interested in the geology of the locality.* Encouraged by the pecuniary results of their discoveries, some of the workmen had supplied spurious shells, obtained from their friends at Liverpool, Southport, or in Ireland; and they had even robbed rockeries and garden-plots that contained shellwork. The shells so obtained were subjected to the action of fire or acid, to deprive them of their epidermis, and to bring out a thin coating of white lime; they were afterwards shaken in a basket of gravel, and this had imparted to them the necessary red tinge. Some of the workmen had operated on West Indian and African shells, specimens of which Mr. Plant produced; and, in an audacious attempt to manufacture a fossil, they cleverly set a *Mactra stultorum* in a piece of Ketton Oolite. The shell, which had the peculiar pink tinge of the species, was so neatly cemented in the Oolite, that an ordinary geologist might have been deceived. One of the workmen had said to a gentleman, who has written to Mr. Plant, 'that they had made a good thing of it; they had deceived the museums of London, Manchester, and Liverpool, and there had been a fine set of people asking them for the shells.' Such a dispersion might lead to very erroneous deductions as to the origin of the Drift of Macclesfield, and he thought it right to mention the fraud to the Society, so that it might be exposed. The thanks of the meeting were given to Mr. Plant for the course he had adopted.——Mr. J. AITKEN read a paper *On certain Appearances of Glacial Action on Rock-surface near Clitheroe.* After a brief description of the chief geological features of the locality, the appearances of glacial action were described as having been found in a channel, like the bed of a stream, on the top of a hill of Carboniferous Limestone between the Ribble and the Pendle Hills. He considered that the channel, and the striations in it, had been effected by the action of moving bodies of ice, charged on the under surface with fragments of rocks, coming from the north at a time when the relative levels of the land and ocean were different from the present, and when the land was slowly rising from the water in which it was submerged.—Mr. Chatwood asked whether the channel might not be an old watercourse. Mr. Parker said he thought not, as it was on the top of a hill, and did not appear on the surface in one unbroken and continuous course.—**Mr. J. Plant** said that evidences of glaciation on the western side of the Pennine Chain were not numerous, as the Millstone-grit and the Coal-measures were too soft to allow a retention of markings made upon them. There was a better chance of striations retaining their permanency on limestone and igneous rocks, and it was mostly upon them that markings had been preserved.—Mr. J. Dickinson said that supposed glacial action had long been under his consideration, and he did not believe that these striations were formed in any such way as Mr. Aitken and others supposed. It was only a few months since, when in the Agecroft Colliery, near Manchester, that he took from the roof a piece of shale, which was common enough, showing scratchings on one side, which, had they been seen at the surface, would have been considered by ninety-nine of every hundred geological observers as glacial striations. He laid a specimen of the shale upon the table, and said that acres of shale more deeply striated could be got, and striations as fine as those at Clitheroe were often enough found on the face of faults. He believed that all these markings were due to an origin different to that which had been attributed to them. He thought that geologists took too contracted a view of the subject; they should go back to that long time called 'the beginning,' when matter was created, probably billions of years ago, when matter was assimilating and forming, and before it was broken up into this earth and planets. Till they could take a grand view of the subject such as that, they would only go on groping with little details which could never be satisfactorily explained.—Mr. Aitken said that in introducing his paper he did not contemplate a new theory, and he certainly could not grasp the comprehensive view suggested by Mr. Dickinson.—Mr. Chatwood said that he should like to learn Mr. Dickinson's ideas as to the formation of striations on the surface. Mr. Dickinson said that he held a view which was entirely in accordance with the Mosaic account of the creation, and it corresponded with every observation he had made in geology. In the remotest past, when the materials of which the earth and the planets were composed were a soft pulpy mass, gradually hardening into the strata as they now were, there were leakings from some strata across the faces of others below. We had the hemispheres formed by coal-basins, and the drawing off from the stratum formerly above the present surface had left marks as plainly behind it as the smoke from a chimney.—Mr. Plant said that the piece of shale shown by Mr. Dickinson was simply a piece of 'slicken-sides.'——Mr. Joseph Whittaker read a paper *On the Outcrop of the Lower Coal-measure Rocks on Boulsworth and Gorple, together with observations on the origin of some rock-basins thereon.* He explained that there was a very large number of detached large blocks of gritstone on the moors in the neighbourhood of Boulsworth, and that one of them was a very fine 'logan.' Many of these stones had large holes on their surface and sides, peculiar to the gritstone; and long examination of those holes had led him to believe that they were made by atmospheric causes, and not by the Druids, as many persons supposed.—Mr.

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* See GEOLOGICAL MAGAZINE, No. VII. p. 41.

Dickinson, Mr. Plant, and other gentlemen, expressed similar views. —*Manchester Guardian.*

EDINBURGH GEOLOGICAL SOCIETY.—I. Of Mr. THOMAS SMYTH'S paper *On the Upheaval of the Shores of the Firth of Forth during the Human Period, with a notice of the recent discovery of flint weapons at Marionville (between Edinburgh and Portobello)*, read December 22nd, and reported in abstract in the GEOLOGICAL MAGAZINE, No. VIII. p. 76, another short abstract (by the author) is here offered, as the former is considered by him very inaccurate. Mr. T. SMYTH writes—

'I stated, in the first place, that, as I had traced Oyster-shells, for a distance of a quarter of a mile from the shore, to a height of about 43 feet above the level of the sea, and as those shells lie beneath a stratified deposit of sand and gravel,—and further, as I had traced the same stratum, though devoid of shells, to a height of 100 feet,—I concluded (having taken many other facts into consideration) that there had been an upheaval of the land to the extent of at least 100 feet since the latter portion of the Post-Pliocene era. I then, in the second place, mentioned the known upheaval of at least 25 feet since the time of the Roman occupation; and I cited the evidence of old men who are still alive, to show that within the last forty years there had been not only a gain of land amounting to 66 feet, but that ordinary high tides forty years ago reached a point on the land which is now elevated 2 feet and 1 inch above the present corresponding tides. I further showed that the foregoing evidence was fully corroborated by the old maps of the district. By a series of measurements, I proved that in the eighty-three years between 1770 and 1853, when the Ordnance Survey was made, there had been a gain of land amounting to 96 feet, and an actual change of level amounting to 4¼ feet. I stated that, although there had been a considerable setting-up of mud and sand in many parts of the coast, yet here there could have been none, as there had been a marked change of level. I concluded, therefore, that the shores of the Firth of Forth were at present rising at the rate of 5 feet a century. I mentioned also, that as flint weapons had been discovered at Marionville sand-pit at a point about 90 feet above the level of the sea, and a mile distant from it, and as two of those weapons had been disembedded with my own hands from the marine stratum that I had traced to a height of 100 feet above the sea-level, I considered that there had been an upheaval of at least 90 feet since man first inhabited the shores of the Firth of Forth.' Mr. Smyth adds—'Additional evidence, which I intend soon to lay before our Society, fully corroborates the facts I have adduced regarding the present rate of upheaval, and shows, beyond a doubt, that the whole southern shore of the Firth of Forth between Queensferry and North Berwick, a distance of 28 miles, and that portion of the east coast which lies between North Berwick and St. Abb's Head, about 24 miles additional, have been upheaved more than 2½ feet within the last fifty years.'

II. February 2nd.—Mr. JAMES HASWELL, M.A., read a paper

On a Glacial Clay at Cornton, near Bridge of Allan,—the same clay in which during the spring of last year the skeleton of a Whale was found, at a depth of 9 feet from the surface. In July last, Mr. Haswell visited the spot, and in a sandy clay, exposed in a burn-section behind Mr. Christie's brick-work, he found shells of what might be termed a Post-Glacial character, and which seemed to have flourished during the close of the Glacial Epoch. These were mostly species characteristic of the Littoral Zone and still inhabiting the Forth; for instance, *Ostrea edulis* (and a peculiar curved *variety* of it, which does not seem to be common now), *Mytilus edulis, Cardium edule,* a young specimen of *C. echinatum, Buccinum undatum, Litorina litorea* (large estuarine variety), and *L. rudis*: also others of a more Arctic kind, as *Trophon scalariforme,* and what seemed to be small specimens of *Tellina proxima.* Besides these, there was a *Balanus*; and, mixed up with the shells, there were pieces of bark, probably of Alder, Nuts of the Hazel, and rootlets and fibres of various marsh-plants. These were all found at a height of about 30 feet above the present level of the sea, and, together with other evidence, seem to indicate that the bed of the Estuary of the Forth has been raised to that extent since these Molluscs lived in it.—Mr. Haswell also gave a *résumé* of the various Cetacean, Phocine, and other remains that had been found in the clay of the Carse of Stirling since the discovery of the first Whale (Airthrie) in 1819; and he described some bones, &c., which had been lying unnoticed in Stirling for some time; namely, a right antler of *Platyceros Dama,* a right antler of *Cervus elaphus,* a skull of a *Bos* (probably *B. longifrons*), a jaw of a Horse, and two jaws of a Shark (Porbeagle ?); all found, when preparing the foundation of the New Bridge at Stirling, in blue clay about 10 feet below the bed of the Forth;—also the skull of a Wolf, found at a depth of 20 feet, and the pelvis of a Horse, found in 1862, when taking out sand 5 feet below the bed of the Forth. Mr. Haswell remarked, in conclusion, that it would be interesting to determine if the clays on the East Coast were of the same age as those on the West Coast of Scotland; but he thought that, as the former had been so little examined, and so much remained to be investigated, it was rather premature to discuss their relative ages at present.

Dr. Selkirk, of Carluke, sent for exhibition some beautifully sculptured scales of *Gyrolepis Rankini,* which he had lately discovered in shale below the Main Limestone (in the lower series of the Carboniferous Limestone) at Braidwood, near Carluke, Lanarkshire.

III. February 23rd.—Mr. GEORGE LYON read a paper *On Chalk, and the Mode of obtaining Foraminifera from that substance.*

Mr. DAVID PAGE made some interesting remarks *On the Fossils found by Mr. Mathieson, of Jedburgh, in the Carboniferous and Old Red Sandstones of Roxburghshire.* Among the latter are a specimen of *Pterichthys major* and a jaw-plate of *Bothriolepis,* which are of peculiar value, as they link these beds to those of Dura Den in Fifeshire.

IV. At the Meeting held March 2nd, Mr. David Page, F.G.S., F.R.S.E., in the chair, Mr. G. C. Haswell, Hon. Sec., read a paper *On the Age and Fossils of the Silurian Beds of the Pentland Hills.* He described, and exhibited drawings and specimens of, all the fossils yet found in these beds, among which were several new species and a number which had not previously been found in this locality. Among the new species are three Brachiopoda, given as new on the authority of Mr. T. Davidson, F.G.S. They have been named *Merista ? Maclareni*, *Rhynchonella Pentlandica*, and *Orthis minuta.* Among the species new to the locality are some Middle Silurian forms, and one specimen of *Pterygotus bilobus*, showing part of the terminal segment and six of the preceding segments tolerably perfect. Mr. Haswell showed that in the beds above the village of Carlops we have probably the equivalent of the Upper Silurian rock, Lower Ludlow and Wenlock Shales, and some red sandstones and shales at the source of the Deerhope Burn which are probably older than the Wenlock beds, but in these last no fossils have yet been found. He also argued that if the order of these beds given by Mr. Salter in the Appendix to the Explanation of Sheet 32 of the Geological Survey Map be reversed, not only would the section, and its relation to the Silurian rocks on the South, be more easily understood, but it would do away with the supposition that in this section we have no less than three unconformities in the Old Red Sandstone.

Glasgow Geological Society.—I. The Monthly Lecture, Feb. 2nd, *On the Age of Ice in Scotland*, was by the Rev. H. W. Crosskey, who has for some time past been engaged in the study of the subject, and also in working out, with David Robertson, Esq., the fauna of the Glacial beds of the West of Scotland, especially the more minute forms. The Lecturer described the position and characteristics of these beds, which he illustrated by numerous diagrams. He said that there were four distinct deposits, representing consecutive periods, during a lengthened and slow upward movement of the land in Scotland, and referred specially to the beds at Fort William, Lochgilphead, Kames in Bute, Lochlomond, Langbank, Paisley, Jordanhill, and Chapelhall, near Airdrie, representing various levels where Glacial shell-beds were now found, varying from half-tide at Langbank to 525 feet above the present sea-level at Chapelhall. To the venerable President of this Society (James Smith, Esq., Jordanhill) is due the honour of establishing the Glacial beds as a distinct series, with a characteristic fauna; and the credit of the scientific men of Glasgow is, therefore, peculiarly involved in developing this chapter in Geology. The term '*Boulder-clay*' is very objectionable as applied to the general collection of clays, sands, and gravels, indicative of a Glacial epoch. It more correctly relates to one term in the series; and great confusion has arisen from the mistake naturally consequent upon a loose phraseology, viz., the predicating for a whole series the conditions of one term. The phrase '*Northern Drift*' is also objectionable; one of the peculiar characteristics of the only bed in which the fauna of the period is preserved being, that it is in no sense a *drift*, but one of the most gradual and quiet of all deposits. The Lecturer then proceeded to develope the following positions:—1. That the Glacial beds of the Clyde district constitute a well-marked series, and cannot be confused together under any one term. They denote epochs separated by long intervals, and characterized by different conditions both of climate and the relative position of sea and land. 2. That this physical sequence is not an accidental circumstance, of one small river-basin, but extends over large areas. 3. That the Boulder-clay proper, at the base of the series, is destitute of fossils. A number of cases in which fossils were said to occur in the Boulder-clay have been examined by the Lecturer, and it has been found that they were either beneath it, or that an Upper Drift has been confounded with it. Mistake upon this point is exceedingly easy. The upper beds often slip down and cover the face of the lower; while the Upper Drift, although differing widely in the obliteration of the striæ on the stones, and its less compact character, is readily mistaken unless studied in connection with a large range of beds. 4. That the finely laminated clay which immediately succeeds the Boulder-clay is also unfossiliferous, and was probably the deposit of rapid waters issuing from beneath ice, and carrying the excessively comminuted mud well known to Alpine travellers. 5. That the fossiliferous clays and sands belong to several ages; and that the fauna usually catalogued together must be separated into distinct groups, each referable to its own bed, and having its own place in the gradual transition from a severely Arctic, to a more moderate temperature. Mr. Crosskey concluded by a description of the probable scenery of Scotland from the time of the Boulder-clay, and through the successive changes, down to the close of the Glacial Period; and expressed his conviction that more minute and extended observations may enable a map of Scotland to be drawn as it was when in the condition of Scandinavia. Every clay-pit, every heap of boulders, undoubtedly has its place in the great order of creation; and we may work in the midst of the mud, in the faith that there is an order and a succession among the loose stones and in the lamination of each bed as definite and exact as that which prevails among the stars, so that not one faileth in its appointed course.

II. At the Monthly Meeting, Feb. 16th, Mr. **John Young** described a large collection of the *Products of the Destructive Distillation of Coal-tar*, exhibited by T. P. Miller, Esq., Springfield; amongst which were tar-oils, paraffine, photogen, ammonia, &c., and specimens illustrating the formation of the Aniline-colours,—benzol, nitro-benzol, aniline, mauve, magenta, blue, violet, yellow, green, &c.; also numerous specimens illustrating the application of these colours in dyeing and printing. Mr. Young said that the art of distilling coal had been known for a considerable time; but it is only recently that the Coal-tar products have come into extensive use. In a Table in the International Exhibition Jurors' Report, Mr. Hoffman enumerates about fifty-one different substances derived from the tar, and doubtless many more will yet be discovered. In the manufacture of gas, the coal is placed in red-hot retorts, by which a maximum of gas is obtained : on the other hand, when the object is to obtain a large yield of oil, the coal is placed in cold retorts, and gradually brought up to a low red heat. The crude tar-oils are then subjected to distillation, among the first products of which are benzol, toluol, &c.; as the heat is continued, 'heavy' or 'dead' oil passes over (which contains much creosote, and is used for the preservation of railway-sleepers), leaving pitch as a residue in the retorts. Some idea of the extent of the paraffine-oil manufacture may be obtained from the fact that no less than 2,300,000 gallons were produced in the United Kingdom in 1862. In 1856 a new and important manufacture was established by the discovery, by Mr. W. Perkins, of the beautiful mauve-dye, derived from aniline, a basic substance existing in tar. Since then this trade has assumed gigantic proportions; and innumerable shades of blue, purple, red, yellow, orange, and black have been obtained. These colours, besides being extensively used at home, are now exported to a large extent; and an eminent chemist has said that in time Great Britain will be the great colour-producing mart of the world.

Mr. JOHN YOUNG exhibited some slabs of Carboniferous shale from Arden Quarry, near Thornliebank, containing numerous specimens of thin bivalve shells, which had long puzzled geologists as to their affinities. Lately he had submitted them to Professor T. Rupert Jones, who informed him that one of them is an *Estheria*, a genus of Bivalve Crustaceans; the one exhibited is a new species, which, from the beautiful punctate structure of its shell, as revealed by the microscope, Professor Jones proposes to name *E. punctatella*. One of the other shells common in this shale Mr. Salter and Professor Jones refer to an American genus of Molluscs (Dr. Dawson's *Naiadites*); the species being possibly as yet undescribed. Mr. Young remarked that these shells occur in great profusion in the aluminous shales of several localities in the West of Scotland; and, being extremely thin in their texture, they are often converted into a thin film of iron-pyrites, which gives them rather a pretty appearance when the shale enclosing them is newly laid open. Both the shells and shales, however, soon decompose if exposed for any length of time to the influence of the weather.

Mr. JOHN HUNTER exhibited an interesting series of Carboniferous Fossils from the 'Main Limestone' beds of the Braidwood district, near Carluke, among which were examples of the interiors of several Brachiopod shells, not found before; also, the very rare *Productus Deshayesianus*, of which his friend Dr. Selkirk was the first to find specimens in Scotland. Mr. Hunter also exhibited a large slab of shale lately obtained by Dr. Selkirk from the strata lying between the 'Main Limestone' and under-lying Coal at Braidwood, which contained a splendid example of a large and very rare fish, *Gyrolepis Rankinii*. This specimen is in good preservation, and shows the beautifully sculptured ganoid scales of the Fish lying in their natural position; also, the large granulated plates which adorned its head. The ornamentation of these plates and scales are peculiar, distinguishing this fish from all others found in the Carboniferous system. This species was first discovered by Dr. Rankin, of Carluke, many years ago, and named after him. Mr. Hunter also exhibited numerous specimens of polished limestone with Corals, &c., and explained his process of grinding and polishing them, by which any member of the Society, with a little labour, and at a very trifling cost, could easily accomplish like results.

The Discovery of Lower Carboniferous Fossils in the Upper Coal-measures.—Mr. R. WHYTE SKIPSEY exhibited specimens of *Productus scabriculus*, *Discina nitida*, *Conularia quadrisulcata*, and *Bellerophon Urii*, recently discovered in the Upper Coal-measures, very greatly higher in the Carboniferous series than previously known.

These fossils are true marine types, and have not hitherto been found higher in the series than about 290 fathoms under the 'Ell Coal,' generally in the Mountain-limestone and its concomitant shales. The specimens now produced were discovered in a coal-pit-shaft on the Drumpeller property, about six miles east of Glasgow. They were enclosed partially or altogether in clay-ironstone-nodules, which were enveloped in shale, a few of the dorsal valves of the *Productus* being in the shale itself. Their position is about 30 fathoms from the surface, over- and under-laid by the usual alternations of sandstones, shales, and fireclays. In this pit the 'Main Coal' is calculated to be 100 to 110 fathoms from the surface; and the 'Ell Coal,' if in its usual relative position to the 'Main Seam,' would be 10 to 15 fathoms higher. The position of the fossil-bed, therefore, is about 60 fathoms above the 'Ell Coal;' the horizon of these varieties of ocean-life being upwards of 300 fathoms higher than hitherto known,—above the regular coal-seams of the Upper Carboniferous strata, while any previously known beds of the kind lie in the middle series; and *Discina nitida*, at least, establishes a connecting link with the Permian beds. The nodules enclosing these fossils are of a brown colour, like hæmatite; and this is really their character, there being only 28 per cent. of iron in its normal state of a carbonate, and 23 as a peroxide: the shale also is purplish red. The cause of this is evidently a large trap-dyke, which, though not in contact at this point, traverses the ground in close proximity, and by transmitted heat has effected this change in colour and character. The *Productus* is most abundant of all, only one or two specimens of the others being got; but great numbers cannot be expected, the extent of the fossiliferous bed turned out being only the area of the shaft, about ten feet square; and it is not above one foot thick. It is, however, a persistent bed, and clearly in its natural position, there being no irregularity nor dislocation visible in it or the strata around, except a supposed downthrow in the whole mass of beds by the action of the trap-dyke, the pit being regarded as on the depressed side.

The reading of Mr. Skipsey's paper was followed by some discussion as to the position of the strata in which the shells were found. Mr. JAMES THOMSON said he thought the Society should be cautious in affirming the discovery announced by Mr. Skipsey, until the position of some well-known bed of coal in the pit was ascertained, as he had often seen marine beds, containing similar shales, thrown up to the surface by faults in the strata.—Mr. JOHN YOUNG, who had lately visited the pit (with Mr. Skipsey and Mr. Stokes, colliery-manager, who knows the district and its strata intimately), and had discovered some of the shells exhibited, stated that he could not agree with Mr. Thomson's objections, as they had carefully investigated the position of the shell-bed, and found that it lay only a few fathoms under the red sandstone which overlies the Upper Coal-measures to the east of Glasgow. All the evidence that could be obtained went to prove that the pit is being sunk in these Upper Coal-measures; and, as there is only one *red* sandstone in this part of the field, the horizon of this shell-bed is as clearly marked as if it were taken from any bed of coal whose position in those strata is well defined. He considered that the discovery of undoubted marine shells on the top of our coal-formation was one of great interest to the geologist.*—Mr. CROSSKEY remarked that the recurrence of one of the shells found in this pit, *Discina nitida*, in the higher group of rocks termed Permian, proves it to have lived throughout the Carboniferous period, and shows how unwise it is to dogmatize upon the limitation or life-range of certain species.

Mr. JOHN CAMPBELL read a paper *On some Differences in the Results of Ice-action in Scotland and Switzerland*, in which he attributed the rounded state of the Highland hills to their having been enveloped almost to their summits in a sheet of ice, while the higher Alpine peaks, on the contrary, at least in modern times, have always been elevated considerably above the glaciers, and have been worn into their present majestic forms by frost and other causes, while the glaciers acted as ravine-cutters and rubbish-carriers. He explained the nature of moraines, and the way in which they were formed on the surface of the glaciers; and gave his reasons for thinking that no mass of detritus intervened between the glacier-ice and its rocky bed, but that all the stones which found their way there were quickly ground into mud, grinding the bed at the same time, and that this mud was instantly carried off by the water which is found abundantly beneath the glaciers. Mr. Campbell admitted that there were very considerable difficulties in fully explaining the phenomena of the Boulder-clay; but suggested that, from the great coldness of the climate of Scotland in the Glacial Period, there would be but a small supply of water from the melting of the ice, and that in the flattish country, where the Boulder-clay is principally found, the ice-sheet would not be much crevassed, so that surface-water would not easily find its way beneath, and the detritus over considerable spaces might thus escape removal. The mass of mud, stones, &c., would then be powerfully compressed and very gradually moved forward by the friction of the ice above; while the stones, being rubbed together while embedded in a slightly yielding matrix, might acquire their characteristic half-worn and scratched appearance. This view of the case would also account for the so-called 'striated pavements,' which would naturally be formed at any level which was for a time the bed of the ice, but which might afterwards be covered up by a fresh mass of clay and stones. Mr. Campbell thought that one of the strongest objections to the Land-ice Theory was derived from the local nature of a large portion of the boulders; though this was generally used as an argument on the other side. He said he could easily understand how stones in a mountainous country might fall on the surface of the ice, and after being carried to a great distance might become involved in the Boulder-clay; but he did not see how ice, creeping over a flat country, which it completely covered, could break up the rocks beneath in large masses, instead of wearing them away by gradual and constant attrition. In conclusion, Mr. Campbell stated that in his opinion the evidence in favour of the formation of the Boulder-clay by a sheet of land-ice predominated; but he did not wish to express himself too confidently on this point, and hoped that observations might be made on the effects produced by close-packed heavy ice drifting in somewhat confined waters, which might possibly throw some light on this obscure and difficult question.

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* Mr. R. W. Skipsey says in a letter, 'At a subsequent visit, I found in the same bed another fossil shell, like *Axinus*: and then examined an old pit 300 to 400 yards distant, making inquiries of the people engaged in working it. Their statement was that at 95 fathoms the "Main Coal" was got, and for years wrought without any obstacles or dislocations; and that the mine was carried within 200 yards of the new shaft, the coal-seams being persistently in their proper place. From the excavated material at the old pit-head I also obtained *Productus scabriculus* and *Anthracosia acuta*, the latter in ironstone-nodules, different from those in which the *Productus* is found, being of a different colour and in their normal state of carbonate. From the position of the Anthracosia-nodules at the pit-head, they must evidently have been got in their usual place in our Coal-measures, ranging from the "Ell Coal" down to the "Main Seam," and thus further proving the general persistent character of the ground. I inquired pointedly of those well acquainted with the ground as to the possibility of an extensive slip throwing up the lower beds, and the idea was scouted as groundless; the only dislocation being the dyke mentioned in my paper which throws the coal down 5 to 10 fathoms on one side: and that dyke was not met with till the shaft was driven 50 fathoms, being 20 fathoms below the newly found shell-bed. There is a total absence of limestone, or anything else, beyond the usual strata of our Upper Coal-measures.' Mr. John Young adds, 'that it would require a hitch or fault of 170 fathoms to bring our highest marine beds to the position of the shell-bed above mentioned: and we have no evidence of such an enormous fault in that district, nor of the Upper Carboniferous Limestone series ever have been reached in any of the pits, which are very numerous there.'

III. March 2nd.—E. A. Winch, Esq., in the chair. The Monthly Lecture was given by W. Keddie, Esq.—*On the Unity and Permanence of Species.* The Lecturer described the views both of those who consider species to be permanent, and limited by strong characters, being types of vegetable and animal life which have survived the lapse of ages unaltered, presenting the same forms and organizations as those of their progenitors; and, secondly, of those who do not believe in the fixity of species, but are of opinion that, in consequence of the modifying influence of external agents upon organized beings, and of the hybridizing or crossing of ancient species, they have been subjected to incessant variation, even in their most important characters, thus giving rise to new types, which are themselves destined to be modified by similar causes. The known permanence of certain animals and plants for several hundred years, and the sterility of hybrids, were adduced as evidence that aberrant animals and plants recur to the type from which they have diverged, and that true species are permanent.

The Chairman, alluding to the admitted progressive character of fossil species, wished that the Lecturer had been able to take into consideration the cause of that progressive advance.

CORRESPONDENCE.

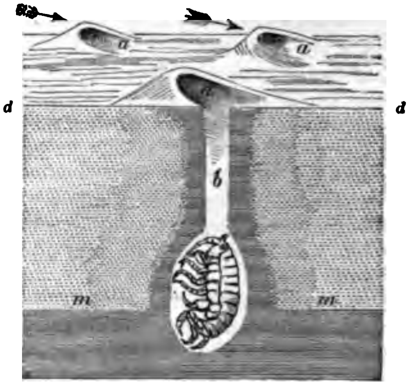
Note on Belemnites clavatus, Blainv.—I am happy to be able to reply to the inquiry of Professor Phillips, regarding the form of the phragmacone in *Belemnites pistilliformis*, Sow. (*B. clavatus*, Blainv.), by the statement that it has proportions similar to those of other *Belemnites*, and is *not* slender and elongated as in *Xiphoteuthis*. A specimen showing this (a guard and phragmacone, in stone, rubbed down and polished so as to exhibit a section) was lately in my collection, and is now, if I mistake not, in the Museum of Practical Geology.

Note on Xiphoteuthis elongata.—Since the publication of Professor Huxley's Memoir, I have obtained a fine specimen (now in the Jermyn Street Collection) of this species. The guard of this example was fractured in extraction from the matrix, and showed clearly that, in this instance at least, it was tubular throughout, though closed at the extremity. From what I have seen in other specimens that have come under my notice, I am strongly of opinion that this is a normal character, and that a solid guard is the result of fossilization.—Edward C. Hartsinck Day, Charmouth.

Surface-Markings on Sandstone.

To the Editor of the Geological Magazine.

Sir,—For many years the peculiar markings found so frequently in sandstone and other rocks, from the Cambrian upwards, have been attributed by Geologists to the effect of heavy rain-drops falling on plastic mud, or moist impressible sand. Together with my fellows, I believed the markings to be due to rain-drops, until a fortunate discovery proved the conjecture untenable. During the summer of 1859, while shooting sea-fowl, shortly after sun-rise, on the sands near Leith, I observed peculiar depressions, with cusps, precisely similar to those so well represented in Plate IV. in No. IX. of the Geological Magazine. They were identical with the depressions caused by rain-drops during a thunder-storm; but as the streets in the town were dry, my curiosity was excited. On calling the attention of a neighbouring watchman to the markings, he informed me that no rain had fallen through the night, and so I looked for another cause to produce the effect. It was not long before I discovered that these depressions were confined to a certain well-defined zone in the sandy shore, none appearing above or below it; further, that they were the burrows of the *Gammarus*, or Sand-hopper. Each of these conical depressions contained water; and as the wind was blowing the sand from above, a cusp was produced round each towards the leeward side of the minute crater. (See Woodcut.) Now, all that was necessary to preserve these Gammarus-burrows, was simply their being filled up by the dry sand, and thus kept from the degrading action of the advancing tide.



TALITRUS (*Gammarus*) SALTATOR, Edw.
The common Sand-hopper in its burrow.
(*a*, *a*, *a*), apertures of three burrows upon the surface of dry sandy beach (*d*, *d*);—(*b*) burrow seen in section around which the sand is always moist;—(*m*, *m*) depth at which the beach is moist at low water. The arrows indicate the direction of the wind.

Another consideration satisfied me that in no instance can we expect to find the fossil marks of rain-drops unless a special condition, such as Gideon of old prayed for, were obtained; namely, that one portion should be dry, and all around moist. For all the casts of foot-prints, gasteropod-tracks, and the so-called fossil rain-drops, one condition is essential,—that before the next tide these markings must be filled up with dry dust or sand. It is therefore clear that no such traces of rain-drops can be found, as all around must have been wet, and the next tide would certainly obliterate any trace of the depressions. Great caution is necessary to distinguish the track of a Gasteropod from that of a Nereid on the soft sand. When the track of a whelk is being filled up by the dry sand blown into the depression *in the line of progress*, no difficulty is felt in recognizing it as the track of a Gasteropod; but should the wind blow at right angles to the track of the Mollusc, a series of setæ-like markings will be observed to leeward, caused by the dry sand adhering to the moist. In this instance a geologist would naturally assign the markings to the impression of *Graptolites pristis* or *G. sagittarius.* And if the wind suddenly shifted to the opposite direction, another series of setæ would be formed on the other side of the Mollusc's track; and the observer would at once pronounce the marks to be due to a gigantic *Crossopodia*, or fringe-footed Annelide.—Yours truly,

A. Bryson.

Hawkhill, Edinburgh.

MISCELLANEOUS.

The Falconer Memorial.—At a meeting held in London on the 25th of February, Sir Proby T. Cautley, K.C.B., in the chair, it was resolved to record the great loss sustained by Science in the early death of the late Dr. Hugh Falconer, and to perpetuate his name as a Naturalist and a Scholar by a suitable Memorial. It was unanimously resolved that this Memorial should include a Marble Bust, to be placed in the rooms of one of the Scientific Societies, or elsewhere, in London, as might be determined. One of the objects in which the late Dr. Falconer took deep interest, up to the latest hour of his life, was the foundation of Fellowships or Scholarships in the University of Edinburgh, to enable deserving students to prolong their studies beyond the usual academical period. It was therefore further resolved to collect funds for the purpose of founding, in that University, a Fellowship or Scholarship in Natural Science, tenable for a limited term of years, and to be called 'The Falconer Fellowship' or 'Scholarship.' The Presidents of the Royal, Linnean, Geological, Geographical, and Ethnological Societies, and many other friends and admirers of Dr. Falconer, have formed a Committee for promoting the objects of the 'Falconer Memorial.'

The late Earthquake in the North of England.—On Wednesday, the 15th of January, an earthquake of very unusual severity occurred in Morecambe Bay, and the neighbouring district of Furness. The following account of the more striking effects is abridged from a long article in the 'Barrow Herald' of Feb. 18th:—About three minutes past 11 A.M., the people of Barrow were terror-stricken by an earthquake-wave which came in the direction of Salthouse Marsh, and passed along towards Hindpool, where it would appear to have terminated. So far as yet known, the vibration would appear to have commenced at Mickle Island in Morecambe Bay, where it threw up large volumes of sand and stones to the height of 5 or 6 feet. Two distinct shocks were felt there, following each other at an interval of five minutes. Roa Island, close by, suffered severely. At the Pier Hotel the walls and ceilings were cracked, and bottles, plates, &c., were thrown down. The cellar seems to have escaped injury. Great fissures were made in the earth 300 yards from the hotel, towards the railway-embankment. At Westfield, Pease Holmes, and Rampside (on the coast), which seems to have suffered most, walls, ceilings, roofs, and chimneys of houses and outbuildings were fissured or severely injured by the shocks: indeed, there are many instances of cracked, bulging, and fallen walls and chimneys. Furniture was thrown down; and in one case at least, the flagstones in the lower rooms were broken and thrown up. At Furness Abbey, the bells of the hotel rang with violence. At Hawcoat, a buzzing noise was heard. The shock, on reaching the shore of Morecambe Bay, would appear to have branched off in two directions,—the one towards Barrow, and the other towards Furness Abbey and Dalton. In Salthouse Marsh it was very severe. Some gentlemen who were standing on the parapet in front of the Barrow Railway-station were nearly thrown down by the rocking of the flagstones beneath their feet. All along the Strand the bells rang in the houses, and the reporter of the newspaper was thrown from his desk against the wall. At Barrow there seemed to be two distinct waves, accompanied by a loud rumbling sound, which lasted about half a minute. All the vessels in the harbour were made to roll and pitch through the severity of the shock. [The writer of the account in the 'Barrow Herald' states that an earthquake occurred at Ambleside in 1780, by which two clefts were produced. One of them was very deep, and 200 feet in length; it nearly swallowed up six houses and several cattle. I have carefully examined, in company with local geologists, a number of large fissures on each side of the valley between Whitehaven and St. Bees, which would seem to admit of no other explanation than an earthquake of comparatively recent occurrence. The tourist on the railway can easily distinguish them by the stripes of wood under which they lie concealed.]—D. M.

RECENT ACCOUNTS from Mexico report the discovery of valuable treasures in that country. Baron de Morner, a Swede, has found a deposit of anthracite of excellent quality in the Guerrero district. Concessions have been granted of a layer of bitumen and two coal-seams in the Arrondissement of Iturbide; of a petroleum-well near Tenancingo; and of a vein of cinnabar at Sultepec. Two Frenchmen, MM. Favre and Garibel, are about to establish iron-mines in the district of Chaleo, where the railway-works are being carried on with great activity.—'*Reader.*'

CONGRESS OF DELEGATES OF THE FRENCH LEARNED SOCIETIES.—M. A. de Caumont, the Director of 'The Institute of the Provinces,' has issued circulars to the Presidents of the several Learned Societies of France, praying the appointment of six delegates from each to meet in convocation at Paris on the 20th of April. The questions which will be submitted for discussion this year, as usual, will bear on Agriculture, Geology, Statistics, Archeology, and Art.—R. T.

THE PALÆONTOGRAPHICAL SOCIETY. — Dr. P. Martin Duncan, Sec. Geol. Soc. (8, Belmont, Lee, S.E.), being engaged in preparing an Appendix to MM. Edwards and Haimes' British Fossil Cora's; and Mr. Henry Woodward (144, Leighton Road, N.W.) having also undertaken to prepare a Monograph of Palæozoic Crustacea, of the order *Eurypterida*, for this Society; they beg to request the kind assistance of Geologists and Palæontologists, and private Collectors generally throughout the country, in forwarding their labours, either by the communication of information as to localities, or by the offer of the loan of specimens for examination, &c.

series and the lowest Silurian rock is a good reason for believing that the gneiss of Bohemia and Bavaria is truly the representative of the Laurentian or Fundamental Gneiss.*

II.—On a Sudden Sinking of the Soil in a Field at Lexden in Essex.

By the Rev. O. Fisher, M.A., F.G.S.

In the month of May, 1861, there occurred a curious subsidence of the soil in a field on the 'Malting Farm' at Lexden in Essex. The cavity thus produced was about twenty-five yards in circumference, of an elliptical form, and about twenty feet in depth, with the sides slightly overhanging. The subsidence took place quite suddenly; some workmen, who were in the field in the forenoon, finding the pit fresh formed on their return from dinner. The ground in which the pit is situated consists of a slightly rising bank of valley-gravel, and is about fifty yards to the south of the little River Colne, which runs past the spot, and gives its name to the ancient town of Colchester. The surface of the field cannot be more than five or six feet above the stream when full.

The sides of the pit are clean-cut in the gravel, which is stratified and has evidently never been disturbed. Though at the time of the occurrence the event excited great local interest, yet I did not myself hear of it until a year ago. I then found it, after a rainy time, containing a little water at the bottom, in the funnel-shaped cavity which was formed of the impervious surface-soil that had subsided ; but it was evidently not spring-water. See the accompanying section.

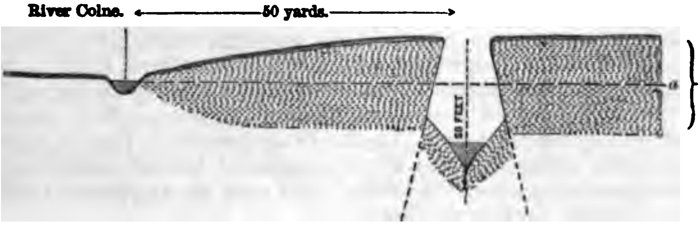


Diagram-section of a Natural Pit near Lexden, Essex.

a. River-level. *b.* Low-level Gravel (6 feet thick above the river-level).

Such are the phenomena : and the question is, how are they to be explained ? The subsoil of the valley is London Clay, which is seen at the bottom of Lexden brick-pit (that cemetery for extinct Pachyderms; see Quart. Journ. Geol. Soc., vol. xix. p. 393), about half a mile distant to the east. It so happens that several Artesian wells have been sunk not far off, so that we know the sequence of beds in the neighbourhood. The late Mr. J. Brown, of Stanway, supplied me with the following section of the well at the Colchester Water-works, which is situated on the edge of the same valley a mile to the east.

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* Quart. Journ. Geol. Soc., vol. xix. p. 359. Looking to the total divergence of their strike, I am of opinion, that the Laurentian rocks of the North-western Highlands, as well as those of the North-west of Ireland, will prove to be the 'Lower Laurentian' of Logan.

Section of the Artesian Well at the Colchester Water-works.[*]

Vegetable soil and low-level gravel . . .	12 feet.
London Clay, with much green sand in the lower beds	105 ,,
Woolwich and Reading beds	25 ,,
Chalk, bored	152 ,,
Plenty of good water at	294 ,,

At another well, which was commenced, but abandoned, at the Cavalry-barracks, about two miles to the south-east of the subsidence, the thickness of the London Clay and Lower Tertiaries was found to be 211 feet, and the Chalk was reached at 237 feet.

Noticing that at the water-works the Chalk was reached at 142 feet, this gives the difference of depth for the top of the Chalk, at the two localities, as 95 feet, which must be very nearly the difference of surface-level of the two places. This shows that the surface of the Chalk is, in all probability, nearly horizontal, and consequently deeply covered by clays at Lexden. We are precluded, therefore, from attributing the subsidence to an ordinary pipe in the Chalk,[†] for such could not have been formed beneath so great a thickness of clays. Had Chalk been the immediate subsoil, such a subsidence might have occurred; for it is probable that the pipes formed by the percolation of rain-water through Chalk are not always filled up by the falling-in of the superficial beds keeping pace with the formation of the cavity. The workmen at Horstead Chalk-pit in Norfolk (where the Chalk is wrought beneath a thick covering of Norwich Crag) assured me that they occasionally came upon hollow pipes, roofed over by the 'uncallow,' i.e. the Crag deposits. This is quite probable, on account of the firmly compacted bed of great flints which immediately cover the Chalk. But such an explanation will not apply to our present problem.

That there must be a vacuity somewhere beneath the subsidence is clear. That it should be in the gravel is impossible, because the stratification, as exposed in the sides of the hole for about 10 feet, is perfectly regular; that it exists in the London Clay is also impossible; but that such a cavity should exist in the Chalk is probable. I conceive it may be connected with the chasm from which the supply of water to the Colchester Water-works is obtained.

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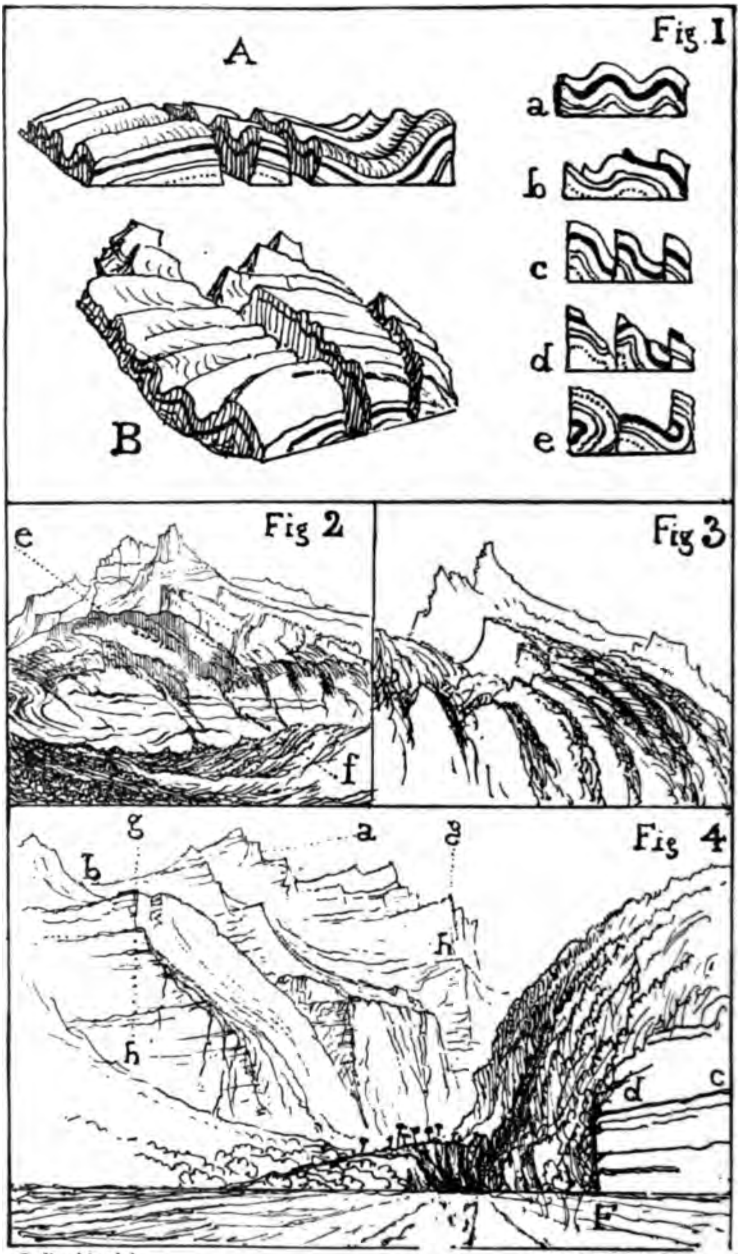
[*] I am indebted to Mr. Prestwich for a correction to Mr. Brown's note, as also for the measurements of the well at the Cavalry-barracks.

[†] See the Author's paper 'On some natural Pits on the Heaths of Dorsetshire,' Quart. Journ. Geol. Soc., vol. xv. p. 187.

Geol. Mag. 1865. *Pl. VI.*



J. Ruskin del. *A. C. Hailes & Co. imp.*

Alpine Structure.

THE

GEOLOGICAL MAGAZINE.

No. XI.—MAY 1865.

ORIGINAL ARTICLES.

I. NOTES ON THE SHAPE AND STRUCTURE OF SOME PARTS OF THE ALPS, WITH REFERENCE TO DENUDATION.—PART II.

By JOHN RUSKIN, Esq., F.G.S., &c.

(Plate VI.)

AT the extremity of my sketch, fig. 1, p. 52, which by the printer's inadvertence is marked Y instead of X, the beds appear to turn suddenly downwards. They are actually more inclined at this spot; but the principal cause of their apparent increase in steepness is a change in their strike. Generally parallel to the precipice, it here turns westwards (*i.e.* towards the spectator); and, holding myself bound in candour to note, as I proceed, every circumstance appearing to make for the modern glacial theories, I must admit that, as the beds at this extremity of the cliff turn outwards from the Alps, it might not inaptly be concluded that the great Chamouni Glacier, which by its friction filed the mountain two thousand feet down at the top, by its pressure turned the end of it several points of the compass round at the bottom!

This change in the strike of beds, though over a very limited space, yet perfects the Salève as a typical example, entirely simple in its terms, of a wave of the undulatory district of the Savoy Alps. I call it the 'undulatory' district, because, in common with a great belt of limestone ranges extending on the north side of the gneissose Alps as far as the Valley of the Rhine, it is composed of masses of rock which have bent like leather under the forces affecting them, instead of breaking like ice; and their planes of elevation are therefore all, more or less, curved.

This is one of the points on which I want help. I have hitherto met with no clear statement of the supposed or supposable differences between the mountains which rise bending, and those which rise rigid. The conglomerates of Central Switzerland, for instance, are raised always, I think, in rectilinear masses, league heaped on league of continuous slope, like tilted planks or tables. But the subjacent limestones of Altorf and Lauterbrunnen are thrown into fantastic curves. The gneissitic schists of Chamouni are all rectilinear; those of Val d'Aoste and the Black Forest are coiled like knots of passionate snakes. Is this difference caused by difference in the characters of the applied forces, or by differences in the state of the materials submitted to them? If by difference in the materials, it is not easy to understand how forces which could twist limestone-beds a thousand feet thick, as a laundress wrings linen, could have left conglomerates in any other state than that of unintelligible heaps of shingle and dust. But if the difference is in the manner of the agency, we have instantly a point of evidence of no small value respecting the date and sphere of any given elevatory force. But I have not yet seen any attempt to distinguish, among the several known periods of elevation in the Alps, those during which the action was accompanied by coiling pressures from those, if any, during which we have only evidence of direct heave. And the question is rendered both more intricate and interesting by the existence of the same structural distinction on a small scale. The metamorphic series, passing from gravel into gneiss, through the infinitely various 'poudingues,' is far more interesting than the transition from mud to gneiss through the schists, except only in this one particular, that the conglomerates, as far as I know them, do not distinctly coil. Their pebbles are wrenched, shattered, softened, pressed into each other; then veined and laminated; and at last they become crystalline with their paste: but they neither coil, nor wholly lose trace, under whatever pressure, of the consistent couching on their broad sides, which first directed Saussure's attention to the inclined position of their beds; whereas limestones in the same transitional relation to the gneiss (those under the Castle of Martigny, for example) wrinkle themselves as if Falstaff's wit had vexed, or pleased, them, and made their faces 'like a wet cloak ill laid up.'

It is true that where the conglomerates begin to take the aspect of shattered breccias, like those which accompany great faults, some aspect of coiling introduces itself also. I have not examined the conglomerate-junctions as I have the calcareous ones, because the mountain-forms of the breccias are so inferior (for my own special purposes of art) to those of the schists, that I never saw [illegible] hours of study [illegible] to show the general difference [illegible] tween [illegible] and the [illegible] tion on a large scale [illegible] by this [illegible] which I have [illegible] that through even the [illegible] there run straight [illegible] cleavages, [illegible] consistent [illegible] angles,—[illegible] at right angles to their direction [illegible] and [illegible] its true beds and minor cleavages, and [illegible]

Putting these regular cleavages [illegible] even if I could [illegible] being as I could [illegible] more than [illegible] the question [illegible] of surfaces, [illegible] usually at right angles to the strike of the [illegible] When that strike [illegible] get combinations of [illegible] and fractures [illegible] lations themselves [illegible]

All these [illegible] sistent agency [illegible] different [illegible] direction [illegible] maxima and minima [illegible] maxima and minima [illegible] forces.

Now, [illegible] ages is [illegible] call 'passive' [illegible] do not care [illegible] what names they [illegible] accept the [illegible] produced by changes in the [illegible] of a rock [illegible] 'passive' [illegible] under given [illegible] strains. [illegible] in large formations, such changes in bulk may involve much over leagues. But I call every cleavage 'native' which has been produced by contraction, expansion, segregation, or crystallization, whatever the space over which the rock may be moved by its structural change; and I only call a cleavage 'passive' which has been caused by a strain on the rock under external force. Practically, the two cleavages, or rather the two groups of cleavages, mingle with and modify each other; but the 'native' cleavage is universal;—the 'passive' is local, and has more direct relations with the mountain-form.

In the range, for instance, of which the Aiguille de Varens forms the salient point, of which the rough outline is given in the same plate, fig. 2, seen in front, and in fig. 4, seen in profile, the real beds dip in the direction *a b*, fig. 4, being conspicuous in every aspect of the mountain in its profile: they are seen again on the opposite side of the valley (of Maglans) at *c d*. On the face of the mass, fig. 2, they are seen to be contorted and wrinkled, on the left reversed in complete zigzags;* but through all these a native cleavage developes itself in the direction *e f*, accompanied by an elaborate network of diagonal veining with calcareous spar.

This cleavage directs the entire system of the descending streams, which, by help of it, cut the steps of precipice into oblique prisms, curved more and more steeply downwards, as the sweep of the torrent gains in power; so that, seen from a point a little farther to the right, the mountain seems composed of vast vertical beds, more or less curved in contour, fig. 3. But the face of the precipice itself is hewn into steps and walls, with intermediate slopes, by a grand vertical passive cleavage, *g h*, fig. 4, to which the direction and disposition of the entire Valley of Maglans are originally owing.

And thus in any given mountain-mass, before we can touch the question of denudation, we have to determine the position it occupies in the wave-system of the country,—the connections of its cleavages with those of neighbouring masses,—and the probable points of maxima elevation which directed the original courses of glacier and stream. Then come the yet more intricate questions respecting the state of the materials at each successive elevation, and during the action of the successively destructive atmospheric influences.

I have no pretension to state more than a few of the main facts bearing on such questions in the Savoy districts of the Lower Chalk, which I will endeavour to do briefly in one or two following papers.

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* This contortion is an important one, existing on both sides of the valley; but it is in reality farther to the left. I have crowded it in to complete the typical figure.

II. ON THE CLASSIFICATION OF THE CRETACEOUS BEDS.

By ROBERT A. C. GODWIN-AUSTEN, F.R.S., F.G.S.

THE two Memoirs by Dr. Reynès, on the Cretaceous formation, which were noticed in the ninth number of the GEOLOGICAL MAGAZINE, suggest two questions: how far the subdivisions there proposed are applicable to the Cretaceous series of this country; and, next, as to the sufficiency of the ground on which the synchronism of the subdivisions of geological formations has been based. The subject of the second Memoir, 'De l'Étage,' involves considerations which might be well extended to the whole range of the geological series: indeed, it will hardly be profitable to make much progress with the past physical history of the earth until rules for determining geological horizons shall be established.

The first of these questions has probably been answered much in the same manner by many English Geologists. Things do not admit of subdivision and the comparison of relative parts, unless they have something in common. Dr. Reynès proposes ten subdivisions for the Cretaceous series, each characterized by from three to four forms of Shells or Urchins. Out of thirty-eight species which are cited, as many as eighteen have not hitherto been recognized within the British area; so that twenty species alone serve for comparison, or an average of two for each 'stage.' This is a small amount of evidence. In that school of Palæontology, however, in which it is a fundamental doctrine that a species has a definite duration in time, and that identical forms, wherever met with, are proofs of synchronism, a single species would have done as well.

The twenty species which have to be removed from Dr. Reynès' list belong to the Mediterranean province of the Cretaceous Period, with which he is best acquainted.

Dr. Reynès' highest horizon[*] is that with *Belemnitella mucronata*, *B. quadrata*, *Micraster cor-anguinum*, and *Hemipneustes radiatus*: this last, a well-known form from the Maestricht and Gulpen beds, has not been found in England. The three other species may be placed thus:—*Belem. mucronata*, *Micraster cor-anguinum*, and *Belem. quadrata*.

These forms, which are abundant in the Chalk of the North of France, of Belgium, and of England, do not occur in the Cretaceous beds of the Mediterranean area; and on such grounds the uppermost division of the series might be supposed to be wanting there. Nor, if recourse be had to considerations which will be noticed in the sequel, can there be any comparison established between the Upper Chalk of England and that of Maestricht.

In the horizon next below the second, the forms cited are *Radiolites*, *Sphærulites*, and *Hippurites*, with *Micraster brevis* and *Ostrea auricularis*. *M. brevis* may be only a Mediterranean-area variety of *M. cor-anguinum*; but the form does not occur with us, nor in the

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[*] Upper Chalk—Chalk of Maestricht and Meudon.

Cretaceous series of the Netherlands; so that the *O. auricularis* is alone available. This is scarce as British; and if, as the observations of Morris and D'Orbigny would lead us to suppose, this species should be the *O. halitoidea* and *O. Rauliniana* of the Gault of France, as of the Gault and Upper Greensand of England, presenting modifications of form according to its duration in time and conditions of life-zone, it can hardly serve the purpose of a 'Leit-Muschel' or 'Guide-Shell.'

The third horizon contains *Ammonites peramplus*, *Am. papalis*, *Am. Deveriæ*, and *Radiolites cornu pastoris*. The second of these is a Mediterranean-area species, *Am. Deveriæ*: only one English specimen has been reported; and the characteristics which distinguish it from *Am. Rothomagensis* are very unimportant. *Am. peramplus* in this country ranges from the Lower Chalk into that without and with flints, through what must represent a vast space of time. *Radiolites cornu-pastoris* occurs on the Atlantic side of France, but 5° of latitude south of our Chalk area.

Division fourth has four typical fossils—*Inoceramus labiatus*, *Ammonites Weilhancii*, *Hemiaster Verneuillii*, and *Rhynchonella Cuvieri*. Mr. Sharpe puts this Ammonite doubtfully as the *Am. Cenomanensis* of D'Archiac, a shell from the Grey Chalk of the South-east of England; but it has been very reasonably suggested that *Am. Cenomanensis* may be only a variety of *Am. Rothomagensis*, and of the extreme stage of its growth. The range of the *Hemiaster* is far south of our area. The *Inoceramus* and *Rhynchonella* have a long range in the Lower Chalk and the Sands next below.

In the next division—fifth—there are two British *Ostreæ*, and an Ammonite—*Am. navicularis*, which is perhaps the commonest form in the Lower Chalk of the North Downs. With it occurs *Ostrea carinata-frons*; but this shell is much more abundant in our sandy beds below the Chalk. Dr. Reynès places *Ostrea Columba* at the head of the series. In Dorset the place of this shell is far below the Chalk. M. D'Orbigny remarks that in the North of France the position of this species is below the zone of *Am. Rothomagensis*, which, so far as our limited data go, holds good for this country also.

The sixth horizon is that with *Turrilites costatus* and *T. tuberculatus*, *Ammonites Rothomagensis* and *Am. inflatus-rostratus*. Here again species are put together which, so far as the English South-east area is concerned, might well stand apart. *T. costatus* is abundant in the Grey Chalk, and *T. tuberculatus* has its maximum in the lower arenaceous strata, with phosphatic nodules: such is also the position of *Am. inflatus*.

M. D'Orbigny states that in the North of France the position of *Am. navicularis* is always lower than that of *Am. Rothomagensis*. Dr. Reynès reverses this order, and puts them into distinct subdivisions. Should both observers be correct, it is a circumstance worth attending to, as showing a different distribution in different provinces.

These six 'horizons' include the whole of the Chalk of England; and, viewed in a general way, the thirteen forms cited may occur here is much the same [illegible] one has such a [illegible] [illegible] of [illegible] to the remaining [illegible] series [illegible] [illegible] in the East and South-east of England [illegible] any part of [illegible] [illegible] conditions.

It is the South and West of France [illegible] separated [illegible] numerous forms of *[illegible]* which [illegible] and which were wanting in our more northern [illegible]. These [illegible] constitute the whole value of the [illegible] arrangement of the French geologists. The remaining forms [illegible] are insufficient for such a purpose. The [illegible] Chalk of the South-east of England [illegible] continuous accumulation, and of [illegible] through a vertical thickness of [illegible] more than a thousand feet. In this the remains of animals [illegible] the mass; and such [illegible] likewise with respect to the Chalk of the North of France.

Dr. Barrois characterises the [illegible] *Belemnitella mucronata* and *B. [illegible]* [illegible] Upper Chalk." The "Upper Chalk" of England [illegible] is merely that portion which [illegible] of the [illegible] of *Belem. [illegible]* [illegible]. The [illegible] "Upper," "M[illegible]" and "Lower Chalk" [illegible] *Belem. [illegible]* [illegible] *[illegible]* each of them has a greater number of characteristic species [illegible] of the White Chalk series of [illegible]. The [illegible] where [illegible] Belgium [illegible] the Chalk of England and the North of France [illegible] the second question raised by Dr. Barrois [illegible] — [illegible] Of this I will attempt an answer in another communication.

III. ON SOME DEPOSITS OF CHERT, WHITE SAND, AND WHITE CLAY IN THE NEIGHBOURHOOD OF LLANDUDNO, NORTH WALES.

By GEORGE MAW, F.L.S., F.G.S., F.S.A., & V.P. of The Severn-Valley Field-club.

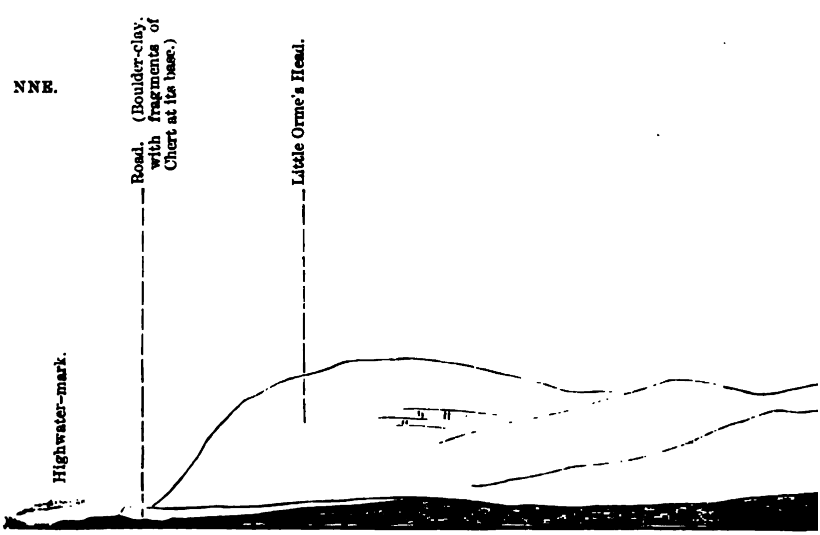
[Plate VII.]

ABOUT a mile and a half to the east of Llandudno, forming the eastern boundary of Orme's Bay, a range of Mountain-limestone runs from the Little Orme's Head on the coast nearly to Conway, enclosing between it and the Great Orme's Head, to the west, a flat tract of ground, which appears to consist for the most part of Boulder-clay overlain by a more recent alluvium.

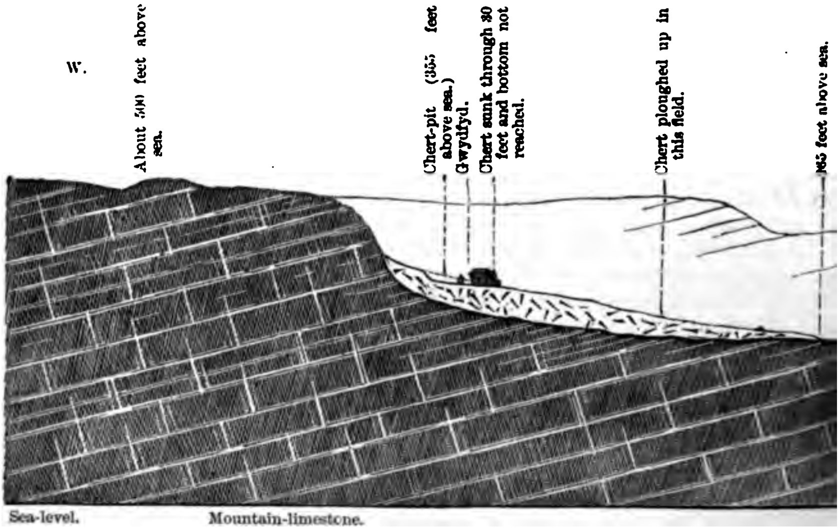
A coast-section towards Colwin, to the east of the Little Orme's Head, exposes the ordinary tough blue Boulder-clay, an overlying reddish loamy clay and sand, and a still more recent alluvial deposit, consisting of tough grey clay, interstratified with seams of peat. Immediately adjacent to the Little Orme's Head the Mountain-limestone is seen coming up under the Boulder-clay, the very base of which consists of a hardish breccia of chert, intermixed with fragments of Mountain-limestone and Mountain-limestone fossils: but the chert would appear to be of a different age from the Mountain-limestone, as I could detect none of the chert-bands which occur, in some districts, in the formation of the neighbourhood; nor did any of the fragments of chert give indication that they had been broken from a limestone matrix. In Orme's Bay, on the west side of the Little Orme's Head, the base of the Boulder-clay is still more largely charged with chert-fragments; and its body, instead of being of the ordinary dark-blue colour, is of a rich ochreous brown. A few feet above high-water-mark, however, the normal colour commences; and here and there, up to the top of the cliff, thin layers of white chert-fragments are irregularly distributed, as though at the setting-in of the Boulder-clay formation large quantities of chert had been denuded, and occasional accessions of the material had continued to take place during the whole of its deposition. I refer to the development of the Quaternary deposits of the neighbourhood, to show that the formations about to be described preceded their deposition, and were being denuded at the commencement of the deposition of the Boulder-clay.

The bulk of the hilly ridge at the back of the Little Orme's Head is principally exposed as naked limestone crags, from 300 to 400 feet in height; but in some places the rock is hidden up to a height of from 200 to 250 feet by débris and Drift, which may probably be, in part, the remains of a once higher extension of the Boulder-clay, as many of the boulders composing it are striated, and appear to have come from a distance.

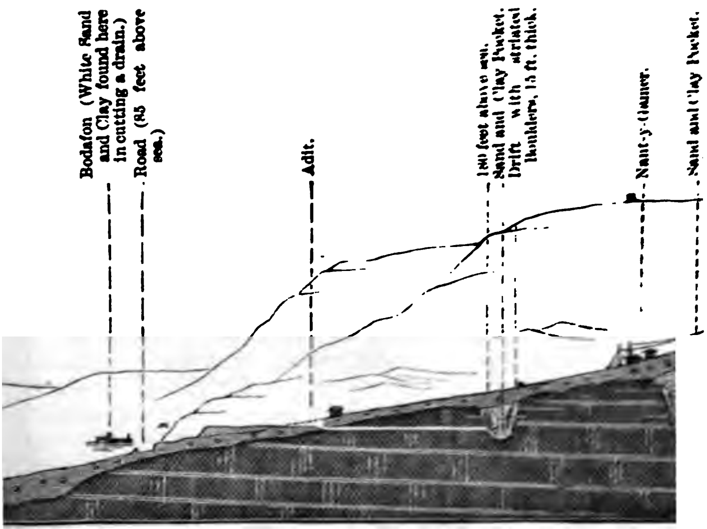
At a spot called Nant-y-Gamer, on the western slope of the range, about half a mile from the sea, a mile from the Little Orme's Head, and a mile and a half to the east of Llandudno, some curious cavities or 'Pockets' occur in the Mountain-limestone, the existence of which has been obscured by the uniform covering of débris. The Drift is here from 10 to 20 feet in thickness, occasionally thicker, and spreads with tolerable uniformity over the solid limestone and



LITTLE ORME'S HEAD. SEC


W.
About 500 feet above sea.
Chert-pit (355 feet above sea.)
Gwyddfyd.
Chert sunk through 30 feet and bottom not reached.
Chert ploughed up in this field.
65 feet above sea.
Sea-level.
Mountain-limestone.

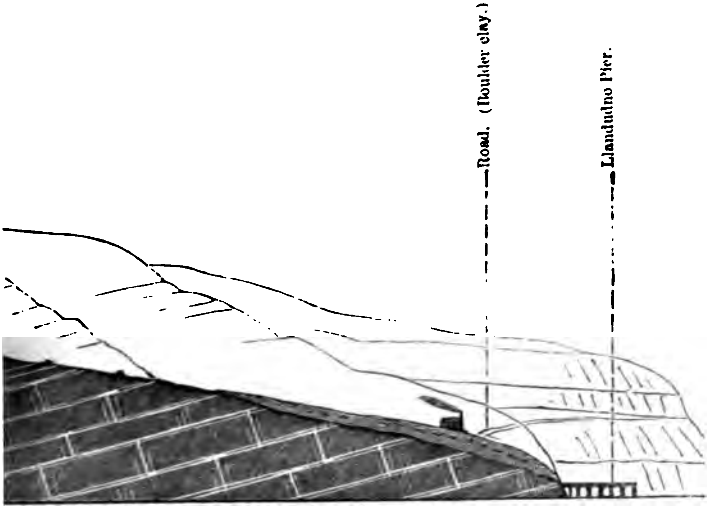
GREAT ORME'S HEAD. SECTIO


Bodafon (White Sand and Clay found here in cutting a drain.)
Road (85 feet above sea.)
Adit.
180 feet above sea.
Sand and Clay Pocket.
Drift with striated Boulders, 15 ft. thick.
Nant-y-Gamer.
Sand and Clay Pocket.

Mountain-limestone.

THE SEA TO NANT-Y-GAMER.

2.



WYDFYD TO LLANDUDNO PIER.

the 'pockets,' the contents of which appear to be of a totally different age and character.

A reference to Section fig. 1, Pl. VII., will best explain the form, size, and relative position of these 'pockets,' and the arrangement of their contents. Three of them are at present known to exist, namely, the two larger ones at Nant-y-Gamer, shown in Section fig. 1, and another smaller cavity, about 32 feet in diameter, at Fferm, half a mile to the south. The surface gives no indication of their existence, and I have not ascertained how they were discovered; but for the last fifteen years workings have been successively carried on by Mr. Thomas Smedley, of Holywell, Mr. Jabez Jones, and Mr. R. F. Steble, of Liverpool, for the white siliceous sand and white clay used in the glass-works; and these have well exposed their structure and contents.

When I first visited Llandudno, in 1853, but one of the 'pockets' was known to exist. It is now worked out and abandoned; and the second, about 180 feet lower down the hill, is being emptied by means of an adit, driven in from the hill-side to about its centre.

The 'pockets' or cavities range from 180 to 280 feet above the sea-level; they are from 100 to 170 or 180 feet in diameter, about 110 or 120 feet deep; and, judging from the upper one, which is tolerably well exposed, their form very much resembles that of an egg-cup, and is altogether independent of the structure of the Mountain-limestone strata, which the sides intersect at right angles.

In aspect they are very much like an old quarry-face, but rather smoother, presenting no hard angularities of fracture, but a mammillated surface, indicating that their excavation must have been by the gradual dissolution of the limestone.

On removing the Drift and Mountain-limestone débris, which was nearly 40 feet thick over the upper 'pocket,' beautifully white siliceous sand is reached, forming the bulk of the contents of the cavities. It is partially discoloured by ochreous stains, which almost disappear in drying; and the sand is occasionally intersected by carbonaceous markings. These are the only indications of organic remains I could detect; but they are so obscure that no definite structure can be made out.

Here and there the sand graduates into patches of very white clay, which is for the most part rather sandy, but occasionally very smooth and soft, resembling the finest kaolin in texture and appearance. Patches of smooth red clay also occur in the white sand.

The exact form of the bottom of the 'pockets' has never been ascertained; the upper cavity was deserted before the contents were completely removed; and the lower 'pocket' is not yet worked out; so it is uncertain whether the cavities terminate with a rounded blunt bottom, or are prolonged into narrow outlets for the discharge of the water which would appear to have been essential in their excavation.

Relative to the method by which these curious cavities have been formed, I would observe that they may have some analogy to the swallow-holes of Tertiary age in the Chalk mentioned by Mr. Prestwich in vol. x. of the Journal of the Geological Society, pp. 222 and

241, several of which are described as being 40 feet in diameter, and 20 or 30 feet deep; and Mr. Prestwich has expressed to me his opinion that the Llandudno 'pockets' may also be eroded swallow-holes.

The absence of horizontal stratification, and the general tendency to a vertical disposition of the materials forming the contents of the pockets, would appear analogous to the vertical and concentric arrangement of the strata filling up the sand-pipes of the Chalk noticed by Mr. Prestwich (Philosophical Transactions, p. 300, part 2, 1864). The gradual dissolution of the limestone and the slowly lowering into the cavity of previously existing superincumbent beds would easily account for their vertical arrangement, which could not have been produced had the contents been *directly* deposited in the cavities from watery suspension.

I am indebted to my friend Mr. Blake, of Newton Abbot, for a careful account of a group of from ten to twenty similar 'pockets' in the Mountain-limestone at Ballymacadam, near Caher, Co. Tipperary, which he says are accompanied by fissures or swallow-holes, that carry away the surface-water, and are supposed to have outlets near the River Suir, about two miles below. The Ballymacadam 'pockets' contain white and grey Potter's Clay, interstratified with Lignite similar to the Bovey-Tracy deposit; and Professor Jukes informs me that they are supposed to be of similar (Miocene) age.

As to the age of the Llandudno cavities, in the absence of organic remains any estimate must be speculative; but, judging from their relative positions on the hill-side, I am under the impression that they were formed subsequently to the range of Mountain-limestone assuming its existing outlines. Their excavation was, however, clearly antecedent to the Boulder-clay Drift, which spreads over the surface, but otherwise forms no part of the contents.

Such steep cavities, however formed, could not have remained long empty; and, when once filled, would not be easily denuded; so that the age of the contents of the 'pockets' must approximately represent the period of their excavation. Indeed, had they remained long exposed as open cavities on the steep hill-side, subaërial débris from the limestone hills must have been largely associated with the material that now occupies them.

A great, and probably the principal erosion of the Mountain-limestone, which may have given the hills much of their present contour, took place soon after the close of the Carboniferous period, as fragments of it enter largely into the Permian Breccia; and Professor Ramsay states that in the Vale of Clywd the New Red Sandstone lies very unconformably on the eroded Carboniferous Limestone.

As far, therefore, as the evidence of superposition goes, the Llandudno deposits might be of any age younger than the Permian and older than the Boulder-clay. All the materials comprising the beds are, however, very unlike in mineral character any part of the Trias, Lias, and Oolite; and on these grounds their probable age would be restricted to the Cretaceous or Tertiary periods.

When I first examined the deposit, I was under the impression, from their close resemblance to some of the clays and sands of Dorsetshire, that they might be outliers of Eocene age; and Mr. Prestwich, who kindly examined some specimens I sent him, suggested, without expressing any decided opinion as to their age, that they could also be matched by some of the Lower Greensand strata of Surrey. Within the last few days I have more carefully examined the district, and ascertained the existence, on the Great Orme's Head, of what appears to be another member of the deposit, which, in connection with the Nant-y-Gamer beds, may possibly afford, by comparison with other formations, a clue to their age, although at present the evidence of organic remains, or of superposition, is unfortunately wanting

On the north-east side of the Great Orme's Head a valley intersects the hill at a little beyond Llandudno Pier, and widening as it ascends, terminates with a broad end at Gwydfyd Farm (see Section fig. 2), against an abrupt precipice of Mountain-limestone. At the foot of this, a triangular space of several acres in extent, less steep than the lower part of the ravine, has afforded a lodgement for a deposit, resembling in colour the Nant-y-Gamer clays, but composed of chert, intermixed with a little light-buff marl. On washing a portion of it, I find three-fourths of it to be made up of chert-fragments of various sizes, and the remainder of the sandy marl. Although no banded structure or stratification is evident, it has the appearance of being *in situ*, and not a drift. It is quite free from fragments of limestone or any other foreign matter; and is evidently the remnant of a once more extensive deposit, from which the chert fragments in the bottom of the Boulder-clay at Orme's Bay was derived.

It appears to entirely occupy the head of the valley at Gwydfyd, as chert is ploughed up all over the arable ground below the Farm-buildings; and the terrace-like form of the space it occupies, which is easily distinguishable at the head of the valley from a distance, clearly defines its range.

Its full depth has never been ascertained; but as the face of the quarry above the Farm-yard, where it has been dug as gravel, is more than 20 feet, and as it was further sunk through near the buildings ten yards without the bottom being reached, a thickness of at least 50 feet seems probable. Its height above the sea ranges from about 250 to 350 feet. At about 100 yards to the north of the Farm-buildings a bed of buff loamy sand occurs by the road-side, which apparently overlies the chert-deposit and is probably connected with it.

A careful examination of the district would probably display a further distribution of the deposit. At Bodafon, N.E. of Nant-y-Gamer, white sand and clay were found in cutting a drain; and I noticed in several places on the Great and Little Orme's Head fragments of buff chert lying on the surface. One of the men engaged at the Nant-y-Gamer sand-pits told me also that similar 'white stuff' was dug a few miles inland near Holywell and Bagillt, and exported to Liverpool. It is not improbable that the Mountain-limestone range along the North-Welsh coast would display more of the 'pockets' similar to those at Nant-y-Gamer; and geological tourists, who may be passing through the district, would do well to examine it with the hope of detecting some organic remains, as until this evidence is afforded the true geological age of the deposit must be somewhat uncertain.

The curious hollows and cavernous openings resulting from the singular irregularity with which it disintegrates has preeminently rendered the Mountain-limestone a preserver of little remnants of later formations: most of the bone-caverns, with Pleistocene remains,—the little Tertiary outliers of Tipperary,—the rich Rhætic remains discovered by Mr. C. Moore near Frome, as well as the Nant-y-Gamer deposits, all owe their preservation to the existence of cavities of various forms and character in the Mountain-limestone, without which they must have succumbed to the process of denudation.

ABSTRACT OF FOREIGN MEMOIRS.

◆

ON THE OCCURRENCE OF FRESHWATER SHELLS IN THE PERMIAN ROCKS OF THURINGIA.

By C. W. GÜMBEL, with Remarks by H. B. GEINITZ. [Neues Jahrbuch, 1864, p. 646, &c.]

ON the south-western margin of the Thüringer-Wald and the Fichtelgebirge occurs a zone of Rothliegende, here and there interrupted, with certain small coal-fields, as those of Erbendorf and Stockheim, in which Plants of Upper Carboniferous age have been found; and at Irmelsberg, near Crock, is a similar deposit, where a workable bed of coal also occurs. Last summer the author visited the last-named place, where a new shaft was being sunk, and was astonished to find a coal-bed which, by its position and the character of its fossil Plants, evidently belonged to the Rothliegende, the lowest member of the 'Permian' of Murchison, and of the 'Dyas' of Geinitz.

The Plants, some of which occurred in the roof and others in the floor of the coal-seam, were determined by Dr. Geinitz to be characteristic fossils of the Rothliegende; but a greater importance was attached to the deposit on the discovery, by Dr. Gümbel, of Freshwater Shells in the same overlying shale in which some of the Plants were found.

The lower plant-bearing stratum,—a fine-grained sandstone, overlying beds known to belong to the Rothliegende,—contains *Walchia piniformis*, Schl.; *Cyatheites confertus*, Sternb., sp.; *C. Candolleanus*, Brongn., and *Calamites gigas*, Brongn.: then follows the coal-bed itself, which has a thickness, at the outcrop, of from 1½ft. to 4ft., and is overlain by a black shale, 1 foot thick; next comes the upper plant-bearing stratum, which is a fossiliferous coal-shale, and contains, in an intercalated layer, Freshwater Shells and an *Estheria*, together with *Walchia piniformis*, Schl.; *Calamites gigas*, Brongn.; *Cyatheites confertus*, Sternb., sp.; *C. Candolleanus*, Brongn.; *C. arborescens; Odontopteris obtusiloba*, Naum.; *Odontopteris*, sp.; *Cyclocarpon Ottonis*, Gutb., and an *Annularia*.

The animal remains are stated by Dr. Gümbel to correspond, for the most part, with those described by Dr. Ludwig from the coal-bearing beds of Manebach, near Ilmenau; and, as the one deposit belongs to the Rothliegende, it follows, of course, that the other is Permian also. The species that have been determined with the greatest certainty are *Unio tellinarius*, Goldf.; *U. carbonarius*, Goldf.; *U. Thuringensis*, Ludw.; *U. Goldfussianus*, De Kon., and *Anodonta ovalis*, Mart. There is also a large form of *Unio* very much like *U. crassidens*, Ludw., and a new and very small species of *Anodonta*, to which the author gives the name of *A. phaseolina*: the latter is about the size of *A. obstipa*, which the author thinks may possibly be an *Estheria;* and it is very much like young individuals of *Unio Goldfussianus*.

The *Estheria*, named *E. rugosa* by Dr. Gümbel, approaches most nearly in form *E. tenella*, Jordan, and *E. exigua*, Eichw.; the ridges being most like those of *E. Middendorfi*, Jones, but not so regular. One remarkable fact in connection with this *Estheria* is that, whereas the shells of the associated species of *Unio* and *Anodonta* are for the most part replaced by iron-pyrites (or sometimes by zinc-blende, galena, or calcite), the shell of the *Estheria* itself has not been mineralized.

In the Appendix, Dr. Geinitz states that this interesting discovery of Dr. Gümbel's has induced him to examine independently the whole of the Freshwater Shells that have been found in the Coal-measures and in the Lower Dyas. With respect to those from near Crock, Dr. Geinitz has come to almost the same results as Dr. Gümbel; the chief points of difference being that the former considers that *Anodonta phaseolina*, Gümb., may perhaps be the young of *Unio Goldfussianus*, and that the shell referred by Dr. Gümbel to *Anodonta ovalis*, Martin, more probably belongs to *A. subparallela*, Portl., sp. Dr. Geinitz differs from Dr. Ludwig, however, in many important points; and he also thinks that the shell described by Mr. Salter as *Anthracomya carbonica* * is really a *Dreissena*.

H. M. J.

GEOLOGICAL NOTES ON MENTONE, NEAR NICE.

By C. H. GAUDIN and MATTHEW MOGGRIDGE, F.G.S. 8vo. pp. 16: 1 Plate. Lausanne, 1865. (From the Bulletin Soc. Vaud. Sc. Nat., vol. viii. No. 52.)

MENTONE is sheltered by an amphitheatre of calcareous hills, composed chiefly of Middle and Upper Cretaceous rocks: a portion of a Belemnite, and fragments of *Inoceramus Cuvieri*, and some Foraminifera, are all that have been discovered in them. The latter are *Textularia globulosa*, Ehr., *Nonionina globulosa*, Ehr., and *Lagena ovalis*, Kaufmann, which are common species in the White Chalk of England, and the 'Danian' of Seeven; but the latter two make their first appearance in the Gault. The limestones of the Nummulitic formation constitute the major part of the Eocene System that is seen in the neighbourhood of Mentone: they are charged with *Nummulites perforata*, D'Orb.; *N. Lucasana*, Defr.; *N. Brongniarti*, D'Arch. (?); *N. Ramondi*, Defr.; *N. Guettardi*, D'Arch.; *N. exponens*, Sow.; *N. granulosa*, D'Arch.; *N. mamillata*, D'Arch., and *N. spira*, De B. (?); and *Opercularia ammonea*, Leym., and *Turritella imbricataria*, Lamk. Grey clays of great thickness, surmounted by compact conglomerates, contain twenty-five species of fossils characteristic of the Upper Pliocene ('*Plaisancien*').

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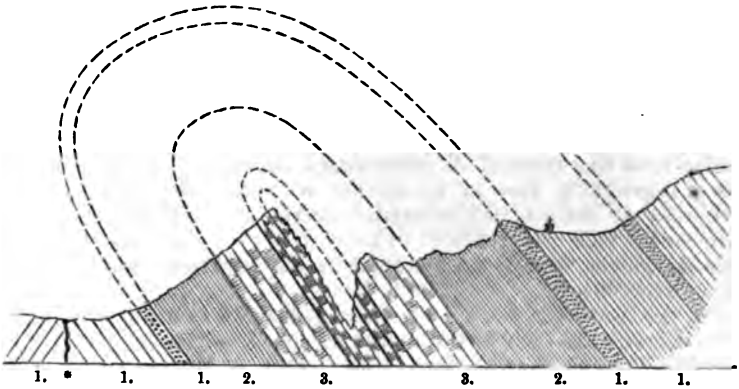
* The shell referred to by Dr. Geinitz was described and figured as *Anthracoptera carbonaria*, Quart Journ. Geol. Soc., vol. xix. p. 79, fig. 3.



Inversion of Cretaceous upon Tertiary Strata near Mentone.

1. Nummulitic Beds (Tertiary). 2. Upper and Middle Cretaceous Beds.
3. Lower Cretaceous Beds. * Fault.

One of the chief points of interest in this pamphlet is that furnished by a part of the section in the plate accompanying the work, representing an inversion of the strata, namely, Cretaceous beds thrown over upon the Eocene.—R. T.

REVIEWS.

THE AMERICAN JOURNAL OF SCIENCE AND ARTS, conducted by Professors B. Silliman, B. Silliman, jun., and J. D. Dana, 2nd Ser. No. 113, Sept. 1864, is rich with geological information, as is usual with this well-known and valued periodical. Prof. E. W. Evans describes the action of Oil-wells in the coal-regions of South Ohio and Western Virginia, based on Prof. Andrews' hypothesis of many of the borings tapping either the bottom, middle, or the top of cavities occupied by gas, oil, or water, highly compressed. Mr. Sterry Hunt continues his 'Contributions to Lithology,' describing certain Dolerites (anorthic felspars with augite) and Diorites (anorthic felspars with hornblende) of Canada;* noticing also instances of 'local metamorphism,' and giving the results of the examination of specimens of a fossiliferous limestone altered by a doleritic dyke.

Dr. H. GIBBONS describes the probable conditions of the springs near San Francisco, where, clay or other impervious rock underlying the superficial strata, the springs and streams reappear at the end of the dry season, as evaporation lessens with the decreasing heat of summer, before rain actually sets in. The New Almaden Quicksilver Mines are described by Prof. B. Silliman, jun.

In the study of a particular seam of coal in Ohio, known as the 'Bear-Creek Coal,' Prof. ANDREWS finds much of interest in its laminated structure, which tells of alternating conditions of deposit, —in its contained pyritous and water-worn fragments of wood—and in its vertical planes of division, contemporary with the hardening the coal, and possibly determined, he thinks, by terrestrial electricity.

Prof. A. WINCHELL notes the finding of the bones of a youngish *Mastodon* two feet under the surface of a small peat-bog in Michigan, and the probability of its having lived with the American Indian. The remains of *Elephas Jacksoni*, Deer, and Elk, accompany those of *Mastodon* in the bogs of Michigan. Dr. SCOTT draws attention to the supposed change of level in a part of the Green Mountains.

Californian Geology and Gold.—Prof. J. D. WHITNEY, giving an account of the progress of the Geological Survey of California, especially notices the great extent of fossiliferous Triassic rocks (St.-Cassian beds, &c.) in the Sierra Nevada, and probably in the Humboldt Ranges, and remarks that 'a large portion of the auriferous rocks of California consist of metamorphic Triassic and Jurassic strata,' that some are metamorphosed Cretaceous strata, and that no Palæozoic rocks have been there recognized. Cretaceous rocks are wide-spread in California and Oregon, usually metamorphosed, but sometimes fossiliferous. The Tertiary beds of the coast-ranges are extensive and various; Mr. Gabb is at work on their fossils. The vast Tertiary formations on the flanks of the Sierra Nevada, which are dug and washed for gold, in the tunnel-mines and hydraulic works of California, are not of marine origin, nor spread out uniformly; but are formed of materials brought down from the mountain-heights in the later Pliocene period, under the action of causes similar to those now existing, but probably of greater intensity, and deposited in valleys, where they filled river-channels and lakes, and often imbedded whole forests, together with remains of land and fresh-water animals.

These great detrital valley-deposits were covered over with volcanic ashes, pumice, and lava-streams, issuing from the higher parts of the Sierra during a tremendous outbreak of igneous energy; and since then, by the wear and tear of weather, the flanks of the Sierra have been further degraded, and hollowed into new valleys; but, protected by their covering of hard flat lavas, these gold-bearing gravels, once lying lower than the surface of the channelled mountain-sides, have been left, to form 'high plateaux between the present river-cañons, and flat-topped ridges known as "Table-mountains," hundreds, or even thousands, of feet above the present river-beds. Thus the topography of the country is exactly the reverse of what it was at the commencement of the present geological epoch: what were once valleys are now ridges, and the ridges of former times were where the immense cañons of the rivers flowing down the western slope of the Sierra now are.'

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* Both of these kinds of instructive anorthisites are alluded to in Dr. Bigsby's paper on the Laurentian rocks in the GEOLOGICAL MAGAZINE, No. III.

Tunnel- and placer-diggings for gold are carried on both in the Pliocene deposits just mentioned, and in the later or Post-tertiary gravel-beds formed since that period of greatest volcanic activity alluded to above. The latter belong to the epoch of Man; for it appears 'that the Mastodon and Elephant, whose remains are so widely and abundantly scattered through California, have been contemporaneous with Man in that region.'

Notices of new facts and views in Chemistry, Physics, Mineralogy, and Geology, and other miscellaneous matter, complete the Number.

No. 114, for November, contains an elaborate paper *On the Origin of the Prairies of the Valley of the Mississippi*, by Prof. A. Winchell, who considers—1. That the soil of the Prairies is of lacustrine formation. 2. That lacustrine sediments inclose but few living germs. 3. That the 'diluvial' deposits, on the contrary, are found everywhere replete with living germs. That the 'diluvial' deposits were buried during the glacial epoch. 5. That in proportion as the 'diluvial' surface become exposed, the flora of the pre-glacial epoch was reproduced. 6. That the vegetation which finally appeared on the drained lacustrine area was extra-limital, and was more likely to be herbaceous than arboreal. Many facts are well grouped together in this paper; and though we do not agree with the author as to the dearth of seeds in lake-mud, nor as to the long-continued vitality of buried seed, yet, in connection with this interesting subject, may be cited the opinion, which some cryptogamic botanists now hold, that the Arctic and Sub-Arctic forms of lichens and mosses, which have been noticed growing upon the ice-carried boulders in Sutherland- and Ross-shire, occupy the life-bearing surfaces of cryptogamous vegetative patches which existed upon the rock before it was drifted southward, into a warmer and more genial clime. Having noticed, during a late visit to the North Highlands, several such boulders, bearing lichens, of species having for a natural habitat a zone very far north of the spot they now rest in, Mr. G. E. Roberts, F.G.S., has called attention to the subject in a letter, entitled 'Boulder Flora,' to the Editor of 'John o'Groat's Journal.' He has suggested therein that some curious results may reward the labours of those botanists who care to scrutinize narrowly the surfaces of such lichen-clad boulders; results which also will bear fruits in the aid they will give to our geological reading of the phenomena of the Post-Tertiary Glacial Age.

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* The gold-bearing shingles of California, and the hydraulic works, are described also ay Dr. Hector in the Quart. Journ. Geol. Soc., vol. vii. p. 404; and those of Peru by D. Forbes, at p. 20 of the same volume.

Mr. D. TROWBRIDGE's Memoir *On the Nebular Hypothesis*, commenced in No. 114, p. 344, &c., will be read with pleasure by many speculative geologists, and is continued in No. 115, for January 1865, which contains an obituary notice of the lamented founder of this Journal. Dr. C. T. JACKSON's account of the *Discovery of Emery in Chester, Massachusetts*, is one of the other articles interesting to geologists. Mica-schist, soap-stone, talc, talcose slate, granular quartz, chlorite-slate, emery (4 feet), chloritoid and margarite, magnetic-iron-ore, and hornblende-rock, are the associated rocks (metamorphic) in North and South Mountains, Hampden Co., Chester, as in Asia Minor. The emery was at first mistaken for ironstone.

GEOLOGY AS A BRANCH OF GENERAL EDUCATION. An Address by DAVID PAGE, F.R.S.E., F.G.S., &c.—Originally delivered to the Glasgow Geological Society, this address now appears as a small 8vo. 40 pp. pamphlet. We have only room to quote a paragraph:—'But while Geology has thus, like other departments of natural science, many intellectual inducements to excite, it has also, like many others, and much more than most, important economical advantages to attract. The rocky crust upon which we dwell is not only the great record upon whose tablets are impressed all the former phases of our planet—thus binding, as it were, by material attributes, the living intellect that interprets, with the divinity of Creative Thought in the remotest past—but it is, at the same time, the foundation of all geographical diversity, the varied habitat of plants and animals, the scene of man's life-labours, the field he cultivates, and the sole storehouse of those minerals and metals upon which the progress of civilization is so intimately dependent. Geology, then, becomes a study of importance to the miner, the engineer, architect, farmer, landscape-gardener, painter, geographical explorer, and all those whose calling leads them more immediately to deal with the internal structure and superficial aspects of our planet. It is by no means expected that these men are to make themselves conversant with all the niceties of geological theory, but merely that they should learn enough to appreciate the leading deductions of the science, and be able to apply them each to his own special requirements. As science can and must often indeed be studied without reference to its ultimate applications, so may the practical man lay hold of the truths of science, and apply them in an empirical way, without being able to work out the problems upon which these truths have been founded.'

THE CANADIAN NATURALIST AND GEOLOGIST, Nos. 4, 5, and 6, August to December 1864, contain—I. 'Elementary Views of the Classification of Animals,' by Dr. J. W. Dawson, F.R.S., &c., in which he proposes to divide the four great groups of Animals (Vertebrata, Articulata, Mollusca, and Radiata), according to their analogies, into four branches, to be called, 1. Nervous, 2. Motive, 3. Nutritive, and, 4. Embryonic or Reproductive Class. Arranged in a tabular form, they serve to express the leading feature of the several divisions of each group of animals. Thus Birds, Insects, Snails, and Acalephs represent the four groups of the Motive class (2).—II. 'On the Fossils of the Genus *Rusophycus*,' by Dr. Dawson. This genus was established by Prof. Hall for certain transversely wrinkled impressions found in rocks of the 'Clinton Group' (Middle Silurian) of New York, and supposed to be fossil Sea-weeds. Similar objects are described by Mr. Billings from the Chazy Sandstone of Grenville, Canada, &c. These curious and irregular bodies, Dr. Dawson believes, may be casts of the impressions of the laminated gill-feet of Trilobites, and that they may have been connected with the place of incubation at the end of burrows.—III. 'Note on the Geology of Eastern New York,' by Prof. Hall and Sir W. E. Logan, being the commencement of a comparison of Eastern New York with Eastern Canada.—IV. 'On the Geology of the Ottawa Valley,' by J. A. Grant, M.D., F.G.S., &c. (being the extract of a Lecture delivered to the Ottawa Natural History Society). This consists of a description of the geological features of this valley, but it requires a map to render it intelligible to a stranger.—V. 'On Peat and its Uses,' by Dr. T. Sterry Hunt, F.R.S. A description of the several Canadian peat-deposits, and the various processes which have been tried for producing from peat-oil, paraffine, wood-naphtha, and sulphate of ammonia. There are also numerous interesting and original Botanical papers.

MEMOIRS OF THE GEOLOGICAL SURVEY OF GREAT BRITAIN.

1. Mr. GREEN'S MEMOIR on parts of Oxfordshire, Bucks, and Northamptonshire, is a careful statement of the facts observed by him in the district surveyed, showing the grounds on which he has mapped its surface, mostly composed of Oolitic strata. Clear woodcuts illustrate some of his points. Whether or not the geological results arrived at are in accordance with those held by others experienced in the mysteries of the Oolitic rocks—their variableness, their homotaxeous difficulties, and such like,—at all events we have a clear and well-written Memoir of careful work.

2. Mr. DREW'S MEMOIR on the Country between Folkestone and Rye, including Romney Marsh, is a succinct, clear, and instructive account of South-eastern England, of which little has been published since the days of Fitton and Mantell. It is only by such close and long-continued examination as the Surveyors make, that the much-broken Wealden district, with its many-bedded shales and sands, can be disentangled and clearly mapped. One of the most interesting facts worked out by Mr. Drew is the up-coming of the 'Ashburnham Beds' (lowest part of the 'Hastings Sands') at Rye, where a deep Artesian boring traverses 330 feet of them,

without getting water. Either this boring or the similar well at Hastings, should be persevered with, if possible, for the sake of solving the problem as to what underlies the Upper Secondary Strata in S.E. England. Mr. Drew's account of Romney Marsh, and of its mode and time of formation is well worthy of praise both for geologist and antiquary.

3. The Explanations of Sheets 187, 195, and 196 of the Geological Survey Map of Ireland and of Sheets 192 and 199 (part), by Mr. J. B. JUKES, with Palæontological Notes by Mr. W. H. BAILY, go far towards elucidating the Geology of South Ireland both by description of strata and fossils, and by the philosophical explanation of observed facts. The first of these two Memoirs treats of the district including the mouth of the River Lee, Cork Harbour, and neighbouring country; the second comprises 'the country round the head of Bantry Bay, and a large part of the mountain-ground between that Bay and Kenmare Bay on the north and the rocky promontory between Bantry Bay and Dunmanus Bay on the south.' These Memoirs treat of—1. The Old Red Sandstone (Lower and Upper).—2. The Carboniferous Slate (including the 'Coomhola Grits') and the Lower Limestone Shale.—3. The Carboniferous Limestone (in the first Memoir only).—4. Drift, Gravel, Clay, Boulders, &c.—5. Alluvium, Peat-bog, &c. The districts described in these Memoirs were surveyed ten years ago and more; but the want of liberality on the part of Government for some years, keeping the Irish branch of the Survey without a resident Palæontological Officer, delayed the determination of the numerous characteristic fossils collected; and hence the delay in publication is not the fault of the Officers of the Survey, but the result of the inadequate means afforded them to carry out their work to completion. The many figures of fossils, and the several sections carefully sketched on wood, and the long lists and careful descriptions of organic remains, are good features in these valuable Memoirs.

THE OSWESTRY AND WELSH-POOL NATURALIST'S FIELD-CLUB AND ARCHÆOLOGICAL SOCIETY. REPORT OF MEETINGS DURING THE YEARS 1857–64; TOGETHER WITH ALL THE PAPERS READ BY MEMBERS OF THE CLUB. Edited by W. W. HOW, M.A.; D. C. DAVIES; and H. M. GWYTHER.

A RICH geological district, with careful and enthusiastic harvestmen, has here produced a good crop of observations, some having reference to discoveries, some enhancing the value of known facts, and all ripened, in the warmth of friendly co-operation, on the sunny sides of the Welsh hills,—often indeed, it seems, interrupted by 'a pouring wet day,' which, however, did not prevent the Members from being 'jolly under the circumstances.' Nor have the Botanists been less active than the Geologists in gathering new facts and re-setting the old ones in attractive discourses. Zoologists and Antiquaries, too, play their part well. And we cannot be astonished at finding this little volume fulfilling the functions of a Naturalist's

Guide-book, when we see the following localities mentioned as having been walked over, and talked over, and written on, by good observers, with open eyes and mutual good-will, giving and taking information on nearly all points of interest. Ellesmere, Llanhraiadr, the Breidden, Treflach, Meifod, Llangollen, Wroxeter, Glyn Ceiriog, Corndon Hill, Coed-y-gaer, Llansaintffraid, Wenlock, Chirk, and the Onney River, are amongst the places visited; and very pleasantly the trips are described, and often with humour. The Conversazione at Oswestry, last December, appears to have been very successful, and four or five good papers were then read, Mr. D. C. Davies's popular account of the Drift-gravel of Oswestry (p. 102, &c.) being a good Geological contribution on that occasion.

GLACIAL LAKE-BASINS.

IN the *Philosophical Magazine* for April, Prof. RAMSAY, criticising Sir Charles Lyell's remarks (in his 'Elements of Geology') on the improbability of glaciers having scooped out large lake-basins, and on the probability of such hollows having been due to unequal movements of upheaval and subsidence, observes as follows:—1. Glacier-ice, widening out on the flats near the mouths of mountain-valleys, must be still pushed forward from behind, and its perpendicular pressure on the ground must be even greater than when it was on a slope: further, that, thinning at its outer margin, the waste of underlying matter by erosion would decrease towards what are now the mouths of the lake-basins.—2. Cup-shaped cavities are not worn by existing glaciers, because these are too petty, neither are they working over plains.—3. Local obstacles, in the course of a glacier or a river, may exist without being regarded as indestructible.—4. In the 'Elements' it is stated that lakes have been present in all ages on the earth, and have been probably connected with upheavals and subsidences. Mr. Ramsay, asking for the evidences of Silurian, Devonian, Carboniferous, Permian, Triassic, Jurassic, and Cretaceous 'lakes,' reminds us that several of the great conglomerates have been, or may be, likened to accumulations of ice-carried boulders,—such as the Lower Silurian Conglomerate of Wigtonshire, the Old Red Conglomerate, the Permian Breccia, the Rothliegende, &c.;—and hence the agency of ice has not been lost sight of in connection with several geological epochs, as also special phenomena in the New Red Sandstone, Oolite, Chalk, and Miocene beds show; and it may therefore be referred to as having been an actual agent, as well as oscillatory crust-movements.—5. As to changes of level in valleys, converting parts of them into lakes, Prof. Ramsay argues, and shows by diagram, that to make the Lago Maggiore basin out of the old valley, the Central Alps must, before the hypothetical depression, have had a height of at least 30,000 feet! Also, that the glaciated undulations of North America cannot come under the hypothesis proposed; nor the Scandinavian and Swedish lakes; nor those of Cumberland, radiating from a centre; as well as others which do not conform to the proposed hypothesis of subterranean movements.

such as a central depression of a mountain-range, converting the valleys into basins, with, however, many modifications of extent, amount, and direction. Prof. Ramsay regards this hypothesis as asking for too great a complication of phenomena to be favourably contrasted with his simple hypothesis, that, as glacier-ice does not erode the rocky floor over which it passes, and as it can, under certain circumstances, move up slopes, the nature of that erosion will be, and was dependent—1. On the angles of the slopes over which it passed when these slopes were seriously appreciable.—2. On the fact that the glaciers sometimes passed from these slopes into low grounds, into which the great old glacier-valleys opened.—3. That at the mouths of these great old valleys, and sometimes near their mouths, where two or more great glaciers met, the downward pressure of all the accumulated ice of all the tributary valleys would be greatest.—4. Because of its inertness in such flat ground, the grinding power of the ice, urged on from behind, would be greatest, in accordance with all known physical laws.—And, 5. That as it progressed and melted, the ice must have been thinner, and must have exercised less erosive power than where it was thick: whence the gradual slope of the bottom of these lakes toward their outflows.

REPORTS AND PROCEEDINGS.

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Geological Society of London.—I. March 22, 1865; W. J. Hamilton, Esq., President, in the chair.—1. 'Notes on the Caves of Gibraltar.' By Lieut. C. Warren, R.E. Communicated by the Secretary of State for War through Sir R. I. Murchison, K.C.B., F.R.S., F.G.S.—The principal caves at Gibraltar are St. Michael's, Martin's, Glen Rocky, Genista, Asylum Tank, Poco Roco, and three under the Signal Station, on the eastern face of the Rock. The author described the chief features of St. Michael's Cave, stating that it is a portion of a transverse cleft through the Rock, and was probably open to view at no very remote historical period; and he briefly noticed the cave at Poco Roco, which he considers to be a portion of the fissure which extends from Bell Lane, in the town, to the village of Catalan Bay, the noise of blasting having been heard on more than one occasion through the apparently solid rock. In conclusion, Lieut. Warren offered his services in the event of a geological survey of Gibraltar being undertaken.

2. 'On the asserted Occurrence of Human Bones in the ancient Fluviatile Deposits of the Nile and the Ganges, with comparative remarks on the Alluvial Formation of the two Valleys.' By the late Hugh Falconer, M.D., F.R.S., F.G.S.—In this communication the author brought together the few instances on record of the occurrence of fossil mammalian remains in the Valley of the Nile; and instituted a comparison between the Alluvial Deposits of the Nile and those of the upper part of the Valley of the Ganges which had come under his own observation. According to certain statements, fossil human bones have been met with in both of these subtropical

valleys; and Dr. Falconer remarked that at the present time the consideration of the general inferences to which these cases lead may probably be of some use. After discussing at some length the cases in which Human and other Mammalian bones had been stated to occur in the Valley of the Nile, Dr. Falconer described the general features of the Alluvial deposits of the Ganges and Jumna, stating what organic remains had been found in them. In a comparison of the two regions, Dr. Falconer observed that there is a striking analogy between the Alluvial deposits occurring along the banks of the Nile on the one hand, and the Ganges and Jumna on the other, the most obvious being the great abundance, in both cases, of argillaceo-calcareous concretions, forming an impure kind of travertine, and in the lowermost beds horizontal deposits of the same material; but that in its poverty of vertebrate remains the former, so far as it has been explored, is a remarkable contrast to the latter. Dr. Falconer then reverted to an opinion expressed by Sir Proby Cautley and himself many years ago, namely, that the *Colossochelys Atlas* may have lived down to an early epoch of the Human Period, and become extinct since; and he concluded with some general observations on the question of the antiquity of the human race, suggested by more recent discoveries.

II. April 5, 1865; Sir R. I. Murchison, Vice-President, in the chair.—The following communications were read:—1. 'On the Tertiary Deposits in the Colony of Victoria, Australia.' By the Rev. J. E. T. Woods, F.L.S., F.G.S.—The author first referred to his former paper on the Australian Tertiary strata, and then described the beds of Muddy Creek, near Hamilton, mentioning the principal fossils occurring therein, especially a species of *Trigonia*: he also stated that the same formation occurs at Harrow, on the River Glenelg, about sixty miles to the north-east, as well as in Tasmania. In discussing the age of these beds he adopted Professor M'Coy's views, that they are of Lower Miocene date; but he considered the Mount Gambier Limestone to be more recent, probably older Pliocene, and the Murray River deposits as possibly holding an intermediate position: the latter he therefore considered to represent the Upper and Middle Miocene of Europe. Older than all these are certain strata occurring at Port Phillip and elsewhere, which the author referred to the Upper Eocene period. In conclusion, Mr. Woods gave a sketch of the salient features of the Bryozoal faunæ of the deposits occurring at Hamilton and Mount Gambier, chiefly for the purpose of showing that the latter is much the more modern of the two,

In a note, Dr. Duncan enumerated the species of Corals which had been sent him by Mr. Woods; but he stated that, although they had a very recent aspect, no exact geological date could safely be assigned to them.

2. 'On the Chalk of the Isle of Thanet.' By W. Whitaker, Esq., B.A., F.G.S., of the Geological Survey of Great Britain.—In this district a bed of comparatively flintless Chalk overlies one with many flints. The higher division, or *Margate Chalk*, contains but few

scattered flint-nodules and shows well-marked N.W. and S.E. joints. The lower division, or *Broadstairs Chalk*, on the other hand, is less jointed, and has many continuous layers of flint. The beds form a very flat arch, as may be seen along the coast from Kingsgate to Pegwell, between which places the flinty Chalk rises up from below that with few flints.

It is remarkable that in this neighbourhood the Thanet Beds are conformable to the Chalk, the green-coated nodular flints at the bottom of the former resting on a peculiar bed of tabular flint at the top of the latter.

3. "On the Chalk of Buckinghamshire, and on the Totternhoe Stone." By W. Whitaker, Esq., B.A., F.G.S., &c.—In carrying on the Geological Survey of Buckinghamshire, the Totternhoe Stone (with its underlying chalky marl), which had been sometimes thought to be the representative of the Upper Greensand, was traced south-westwards into a part where that formation was fairly developed, and was then found to overlie it.

The divisions of the Chalk in Buckinghamshire are, in ascending order,—

(1) Chalk-marl, with stony layers here and there, and at top.
(2) The Totternhoe Stone, generally two layers of rather brownish sandy chalk, hard, with dark grains of small brown nodules.
(3) Marly white chalk without flints.
(4) Hard-bedded white chalk without flints, forming generally a low ridge at the foot of the great escarpment.
(5) The chief mass of white chalk without flints, or with a very few flints in the uppermost part, and at top.
(6) The Chalk-rock, already described in the Society's Journal, a thin hard bed or beds with green-coated nodules.
(7) The Chalk with flints, the uppermost part, only coming on near the top of the escarpment, the [illegible] bed [illegible] over the table-land southwards, the angle of dip being rather more than the slope of the ground.

4. "On the Chalk of the Isle of Wight." By W. Whitaker, Esq., B.A., F.G.S., &c.—The chief object of this paper was to show that here, as in Oxfordshire, &c., the division between the Chalk with flints and Chalk without flints is marked by a peculiar bed ("Chalk-rock"), hard, of a cream-colour, and with irregular-shaped green-coated nodules, which may be seen in many of the pits on the southern flank of the chalk-ridge, where, however, it is very thin.

The author disagreed with the inference that the Chalk was eroded before the deposition of the Tertiary beds, which has been drawn from the irregular junction of the two in the cliff-sections, and thought that the irregularity had been caused rather by the formation of "pipes" after the deposition of the latter, although he did not deny that there was other evidence of denudation of the Chalk before the deposition of the Tertiaries upon it.

Royal Geological Society of Ireland.—I. On March 8, there was a meeting of this Society in the New Museum, Trinity College; Dr. A. Carte, Vice-President, in the chair. Mr. Scott read a paper by Mr. W. **Harte**, C.E., *On some Crumpled Granite Beds in Donegal.* The author stated that attention had frequently been drawn to the gneissose character of the granite of that county, especially by the Committee who had presented a report on the subject to the British Association. In parts of the district, patches of schists, highly contorted, are found caught up in the granite, which latter rock appears at times to pass into schist. The point to which he wished to direct the notice of the meeting was the occurrence of thin slabs of gneissose granite alongside highly crystalline masses of the same rock. In one place, on the road between Dungloe and Maghery, he discovered a series of these thin beds as highly contorted as are the schist enclosures before referred to. These beds vary from one inch upwards in thickness, and may be traced for some distance along the shore. This was the only place where he had observed this phenomenon; and he sent up some specimens of the contorted granite, and also a specimen of the granite from the immediate vicinity, which did not exhibit the same contortions, but was traversed by joints to such an extent as to render it useless for building-purposes.—Mr. **Scott** observed that Mr. Harte was a very careful observer, who, as they well knew, had added much to their knowledge of the Geology of the County. His own recollection of the immediate locality referred to was that there was a considerable amount of schist included in the granite; and at one locality at no great distance, called Toberkeen, there was a bed of limestone, which contained an abundance of garnet and idocrase, indicating considerable metamorphic action. The granite about Dungloe, and in the Rosses generally, was very coarse-grained, and it was highly interesting that Mr. Harte should have found it to be contorted.

Mr. Jukes then took the chair, and Dr. **Carte** read a paper *On some Indented Bones of Cervus Megaceros, found near Lough Gur, County Limerick.* Dr. Carte referred to Mr. Jukes' former account of indented bones from a bog in Longford (see Geological Magazine, No. VII. p. 28), and stated that he had been supplied by Mr. Hinckley, of Limerick, with the indented bones exhibited to the meeting—namely, a right humerus, right and left radii and ulnæ, right and left cannon or metatarsal bones, left os calcis, and the helm of a left horn. An account of the place where they were got was given in a letter by Dr. S. Bennett, of Bruff. The marks on the bones, and the relative positions when found, were described in detail. A polished depression on the left cannon-bone fits into one on the left tibia, and similarly the left radius fits against the right cannon-bone; and another concavity in the same cannon-bone fits into the left os calcis. A rough deep cut-like indentation across the right radius and ulna fits a deep cut in the posterior edge of the palm of the left antler, imbedded in which the bones were found. So also the right humerus was found in contact with the posterior and most distant tire of the left antler, by which it had been deeply scored, and about six inches of which it had severed from the palm.

Dr. Carte said that in a former discussion upon a paper by Professor Jukes, relating to bones of *Cervus megaceros* found under circumstances similar to the present, the differences of opinion resolved themselves into three hypotheses. Mr. Jukes held that the abrasions were produced by pressure. Another hypothesis was, that the marks were produced by the hand of man. The third was, that they were the result of the friction of the bones lying upon one another, that friction having been produced by motion for which it was not easy to assign a cause. The last was the doctrine that he himself broached, and he thought that his view was borne out by the specimens now before them.

II. On the 12th inst., Dr. Carte in the chair, Captain R. F. Burton, Her Majesty's Consul at Santos, was elected an Honorary Fellow.

Mr. W. H. S. Westropp read a paper *On a Trap-rock at Bray Head, County Wicklow.* This greenstone was discovered by Professor Harkness, who told Mr. Jukes of his having found it. Mr. Jukes showed it to the writer, by whom it was examined in detail. After describing the position, mode of occurrence, and nature of the rock, Mr. Westropp brought forward arguments to prove that it was an intrusive trap, for it might be seen sending veins into, and cutting across beds of, the adjacent sedimentary rocks. He concluded by observing, that, while there was such a profusion of igneous rocks associated with the Cambro-silurian deposits of Wicklow, it was rather remarkable that one small greenstone-dyke, at Greystones, and the greenstone he had just described, were the only trap-rocks which had yet been found in the Cambrian rocks of that county.

Mr. Jukes corroborated Mr. Westropp's observations; and stated that he knew of beds of intrusive greenstone running evenly between other beds for miles in length and breadth, preserving almost the same thickness throughout, and not appreciably altering the beds above or below. He also remarked that probably the igneous rocks, so abundant in the lower Silurian beds, had passed through the Cambrian beds below by few and narrow channels, such as the dyke described by Mr. Westropp.

Mr. W. H. Baily then read a paper entitled *Some Additions to the Structure of Palachinus.* He stated that since his last communication to the Society on this subject, he had been enabled to examine an additional specimen of *Palachinus ellipticus*, which had been presented to the Geological Survey by Mr. M. G. Ryan, who had been fortunate enough to knock out two of these rare fossils from a block of limestone used in the construction of a drain at Bettyville, near Croome, County Limerick. Mr. Baily remarked that this fossil was in the state of a cast; the matrix in which it had been embedded, having retained the test or shell, had been left behind; and he urged the necessity upon collectors of preserving both sides of a specimen, one of which often served to elucidate particular parts, which may have been obscure on the other. He believed this fossil exhibited some additional particulars with regard to the structure of its shell with which we were not before acquainted. In the first instance, he thought there was good evidence of a mouth opposite to the apical disk, corresponding with a similar arrangement of parts in the recent *Echini*, the parts appearing to have terminated in a slightly reflected edge. The arrangement of the apical disk alone in *Palæchinus*, corresponding as it does so generally with more recent forms of *Echini*, would entirely set aside the notion as to their having been provided with stalks like the Crinoids, and, in his opinion, proved them to have been more nearly related to the free Echinoderms, of which the recent *Echinus* is a typical example; and he stated that this fine fossil assisted very much in confirming him in this opinion, as it appeared to have a distinct oval termination at the opposite pole to that of the apical disk—an arrangement entirely in accordance with its other structural peculiarities.

Captain HUTTON and Dr. FRAZER exhibited specimens of the Green Serpentine Marble of Connemara containing *Eozoon*, as indicated by Mr. W. A. Sanford (see GEOLOGICAL MAGAZINE, No. VIII. p. 87).—*Saunders's Newsletter.*

THE EDINBURGH GEOLOGICAL SOCIETY.—March 23; Maurice Lothian, Esq., Vice-President, in the chair.—Mr. THOMAS SMYTH read a paper *On the Glacial Drift of the North of Germany*, being observations made by him during a tour on the Continent in 1860. He first described the Tertiary deposits which lie beneath the Drift, the Eocene beds covering a large portion of the North of Germany. Most of those beds, he said, are of the same age as the 'Calcaire Grossier' of the Paris Basin, and the Bagshot and Bracklesham beds of England. They extend from Germany to Novo-Moscov in Russia, within about 150 miles of the Sea of Azov, and are upwards of 1,100 miles in length, having an average breadth of nearly 200 miles. During the Eocene Period a shallow sea had covered the whole of that expanse, and formed a sort of shallow Mediterranean in Central Europe, the climate of that region being sub-tropical. Mr. Smyth then proceeded to give in detail the characteristics of the Scandinavian Drift in Schleswig and Holstein, Mecklenburg-Schwerin, Hanover, Prussia, &c. In the low grounds of those countries the Drift consists of isolated, but often extensive, clusters of boulders, embedded in the stratified sands and sandy clays, and of large erratics which rise above the surface. These isolated masses form the only equivalent in age of the tenacious Boulder-clay of the British Isles. The sands and sandy clays in question (with the boulders) occupy the whole space between the Tertiaries and the vegetable soil. The embedded boulders and erratics are composed chiefly of gneiss, greenstone, porphyry, granite, and basalt; and are of the same mineralogical character as the rocks which compose the mountains of Norway and Sweden. From minute observations which he made at many places, Mr. Smyth arrived at the following conclusions:—(1) That a glacial sea covered the plain of the North of Germany during the greater part, if not the whole, of the Post-pliocene

Period; and this, he said, was proved by the arrangement of the stratified sands and sandy clays, by marine shells of an Arctic type that have been found in them, and by the embedded boulders and surface-erratics from Norway and Sweden, which could not have been transported by land-ice from a distance of 400 or 500 miles to heights, in some places, of 1,100 feet above the level of the Baltic. (2) That the heights at which those erratics have been found lead us to believe that this glacial sea must have been at least 1,100 feet in depth; but several other circumstances would lead us to infer that it may have had a depth of 2,000 feet; and the only reasonable way of accounting for the position of those erratics, as well as of the isolated clusters of boulders in the sands, is, that they had been transported to those places by icebergs and ice-floes. (3) That, if the Plain of the North of Germany during any part of the Post-pliocene epoch had enjoyed a sub-aërial condition, it must have been as sandy and as barren as the desert of Zahara; for we have no proof either of land-glaciation or of sub-aërial vegetation; and the few remains of the land fauna and flora that have been found, frequently in juxtaposition with sea-shells and the skeletons of Whales, must have been borne to the low grounds by rivers and marine currents.—Mr. D. J. Brown read a notice of the *Occurrence, near Granton, of recently formed Sandstone, containing Shells of living Species.*—G. C. H.

GLASGOW GEOLOGICAL SOCIETY.—At the Monthly Meeting, April 10th, the Rev. H. W. Crosskey in the chair, Dr. WILLIAM GROSSART, of Salsburg, parish of Shotts, sent for exhibition a specimen of a little fossil fish, belonging to the genus *Palæoniscus*, got by him in the coal-shale of that district. It measures only an inch and a half in length, and is probably an undescribed species, being marked by much stronger striated scales than any of the species hitherto found in our coal-field.

Mr. JAMES ARMSTRONG exhibited *specimens of the masticating organs of Dithyrocaris*, a crustacean of the Carboniferous Limestone series, from Orchard Quarry, where they are not uncommon. They present the appearance of a group of small blunt crushing teeth, and generally are found in ironstone-nodules, and in greatest perfection when, by the wearing away of the surrounding matrix, they have not been too long exposed to the action of the weather. The only notice of their occurrence is in the 'Report of the Geology of Londonderry,' where two are figured and described by Portlock as probably connected with the masticatory apparatus of *Dithyrocaris*, with the remains of which they are stated to have been found. At Orchard no portion of the carapace or tail has yet been discovered; but Mr. James Bennie, one of the Members, had recently found in a quarry near East Kilbride a half-opened carapace (which was exhibited to the meeting) showing in the interior two groups of these teeth (?), with the tubercles in contact, and evidently not far from their normal position. Mr. Armstrong also exhibited specimens of *Nautilus tuberculosus* from Arden Quarry and Carluke, and

Pleurotomaria Youngiana from Craigenglen, Campsie, species both new to the Carboniferous rocks.

The CHAIRMAN exhibited a suite of the Carboniferous fossils from Belgium (which he owed to the kindness of Professor De Koninck), and pointed out their relation to those of the Scotch Coal-measures. With great generic identity, there are slight specific differences, such as exist over similar areas at the present day. The philosophical problem involved, he said, is the connection between contemporaneousness of formation and identity of species. It would appear that the probability of the contemporaneousness of identical species in any formation is in inverse proportion to the extent of area. Over limited areas nearly identical species were probably contemporaneous; but with extension of area identity of species becomes a valid argument against contemporaneousness.

Mr. JOHN SUTHERLAND read a paper *On Silica, and its Mode of Formation in the Earth's Crust.* After some introductory remarks, he said, that of all the components of the earth's crust there was perhaps no other substance so universally present as silica, a compound of silicon and oxygen ($Si\ O_3$). It may be called the bone or skeleton of the earth, giving hardness and compactness to all its covering. It is a principal constituent of granites, porphyries, clays, slates, &c.; in its purest form it is found as sand, flint, quartz, and in more attractive forms as rock-crystals, opal, chalcedony, cairngorms, and many other minerals valued for their beauty. There are three varieties of silica: the *crystallized*, represented by quartz-crystals, with a specific gravity of 2·6; the so-called *crystalline*, represented by common flint, with the same specific gravity, and which is supposed by Rose to be an aggregation of crystals so small as to be undiscernible by the highest power of the microscope; and the *amorphous*, which is entirely devoid of crystalline structure, and has a specific gravity of only 2·3. Rose's chief reason for supposing the crystalline variety to be built up of minute crystals is simply that it, like the first-named variety, polarizes light, and is unacted upon by alkaline solutions. Now, it is found that when silica of the specific gravity of 2·6 is subjected to fusion, its specific gravity is reduced to 2·3; and this fact has of late been made to occupy an important place in discussions regarding the aqueous *versus* the plutonic origin of certain rocks. The Plutonists assert, for instance, that granites are the result of fusion by heat; but on fusing it, its quartz or silica is reduced to the density of the amorphous variety obtained by precipitation from a solution, and besides will not crystallize. On the other hand, the latter process fails in producing silica of the specific gravity of 2·6. By subjecting the silica, however, to a high temperature under great pressure of aqueous vapour, crystals having that specific gravity are obtained. Mr. Sutherland having stated some grounds for believing that crystallized silica may be produced in nature, without the aid of water, then referred to the subject of flints in the chalk-beds, and fossil shells filled with hard compact silica of the crystalline variety—a subject which had long puzzled geologists, and which has had hitherto no satisfactory solution. By bringing however to our aid a form of solution of silica of comparatively recent discovery, we might arrive at a possible theory on this subject. The solution of silica in question was one of the many products of Dr Graham's process of dialysis, by which all substances soluble in water are capable of being divided into two classes—*Crystalloids* and *Colloids*. Silica belongs to the latter class; and the difficulty of obtaining a strong solution of it, prior to Dr. Graham's discovery, was the impossibility of getting rid of the crystalloid substances always accompanying its solution. By the process of dialysis however a solution of pure silica can readily be obtained, and which, after being condensed by evaporation, gelatinizes, and when dried under the receiver of an air-pump, is, in fact, artificial hyalite, or opal, having the constitution and all the properties of that mineral. This is a pure amorphous variety of silica, with the specific gravity of 2·2; and the argument in favour of flint, chalcedony, and the like, having a crystalline structure, is the fact of their specific gravity being the same as that of the crystals of quartz, 2·6; but that we must take into consideration the fact that our amorphous variety is prepared under the ordinary pressure of the atmosphere, whereas flints, the quartz of granites and other varieties of silica, having the high specific gravity, are, in all probability, formed under great pressure, which may sufficiently account for their higher density. Silicates of soda or potash are infinitely more soluble under great pressure than in the atmosphere; hence beneath the strata of the earth's crust a more concentrated solution of silica would doubtless be produced. We have silicates of soda and potash, and we have also hydrochloric and carbonic acids often freely evolved, decomposing the silicates and precipitating the silica; and that this may be the mode of production of many of the pure siliceous formations I conceive might be safely assumed; at all events, from a chemical point of view, it seems the most likely theory. But then, how are we to get rid of the chloride of sodium produced along with our quartz, and incorporated in its structure? Dr. [illegible] has suggested that possibly beds of sandstone may have acted as dialyzers in separating colloid from crystalloid substances, by which quartz would be formed from a silicate of soda or potash as already explained. From an experiment made by Mr Sutherland, he thought this dialyzing medium was not required. The gelatinous silica artificially produced is itself permanently dialytic, and appears to possess a contractile power, by which, combined with the dialysis, it throws out all extraneous salts. He had laid aside a piece of it in a dry place, when the salt it contained at once began to effloresce from its surface, while it continued to shrink up into a substance having the hardness of common resin, and not unlike the cairngorm in appearance; it continued to shrink even after it had become comparatively hard; and although reduced to one-fourth of its original mass, it retained its shape entire. Metallic oxides brought into contact with it in this gelatinous silica, produced all the colouring and variegated appearance that characterize many of our pebbles; there was also a great similarity in fracture between the natural and artificial silica: and these circumstances taken together tended very much to strengthen the arguments he had adduced in favour of quartz and its analogues being produced in the way described, viz., by decomposition of silicate of soda with an acid, the latter being in all probability either hydrochloric or carbonic acid. The facts he had adduced certainly seem to point to a solution of some of the difficult problems of the earth's crust, and must at least be worth remembering by geologists when speculating on the various phenomena which attracted their attention.

Mr. GEORGE SOMERVILLE, Lennoxtown, read a paper *On the Geological Features of the Country around Jerusalem, from observations made by him on a visit to Palestine and Syria in* 1860.

BRISTOL NATURALISTS' SOCIETY.—I. *Geological Section*, January 16; Mr. A. Leipner in the chair. Mr. W. Sanders was re-elected President, and Mr. F. Ashmead Secretary of the Section, for the ensuing year. The accounts for the preceding year were read and passed.—Mr. W. W. STODDART continued his paper *On the Cambro-Silurian Strata and Fossils*, taking as his subject the Llandeilo Formation, which, he said, could not be distinguished lithologically from the Lingula-beds spoken of at the previous meeting, but which contained an entirely distinct set of fossils, more numerous in species and genera, and of much higher organization. This series is about 5,000 feet in thickness, consisting chiefly of dark slates and sandy flags, and is best observed at the Stiper Stones of Shropshire, Builth, Llangollen, and Llandeilo: the author also examined it at Llandewi-Felfrey, eighteen miles north of Tenby, where many characteristic fossils were found in great abundance, amongst which were *Trinucleus*, *Didymograpsus*, *Asaphus tyrannus*, and a *Discina*, probably *D. Portlocki*, not before found in this formation. Going on towards Lampeter, near Tenby, the beds are found to be first arenaceous, then calcareous; and are extensively quarried, being the only Lower Silurian beds in Wales used for lime-burning. In Scotland the series occurs from Dumfries to the Lammermuir Hills; and in Sutherlandshire it contains several species of shells unknown in the Welsh series, but common in the North American. The altered quartzose and gneissose rocks of Sutherlandshire are known to contain the same Annelid-tube (*Scolithus linearis*) as the Shropshire series. In Ireland the Llandeilo beds had not yet been properly made out, but foreign equivalents were described in Bohemia and Scandinavia. Mr. Stoddart gave a long list of the characteristic fossils of this series, remarking that Encrinites first make their appearance in it, and exhibited specimens of many of them.

II. *Geological Section*, Feb. 23; Mr. W. Sanders, President, in the chair.—Mr. W. L. CARPENTER read a paper on the *Eozoon Canadense*, the earliest known Fossil, recently discovered in Canada,—the generic name signifying 'dawn-animal.' After a few preliminary remarks upon the circumstances under which the paper was prepared, the author stated that this fossil had been found in a group of beds which had hitherto been considered as destitute of organic remains, and the position of which he described somewhat minutely, in Scotland, in Central Europe, where they attained a thickness of 90,000 feet, and in Canada, where they were considered as forming three divisions, Lower and Upper Laurentian, and Huronian, the united thickness of which probably far surpasses that of all succeeding rocks. The presence of organic remains in this series of rocks, both in Europe and America, had long been suspected on mineralogical grounds; but it was not until the winter of 1863–64 that remains were found in the Lower Laurentian limestone, which proved to be undoubtedly organic, from careful microscopical examination. These fossils resembled some of the oldest known Corals in external appearance, occurring in large irregularly shaped masses; but Dr. Dawson, of Montreal, discovered that their structure was most nearly allied to that of the Foraminifera, a group of animals of the lowest form of organization, of which, however, the living recent examples were very minute, while these fossils were comparatively gigantic. Specimens had also been very carefully examined by Dr. W. B. Carpenter, whose knowledge of this group is profound, and who, while corroborating Dr. Dawson on the general reference, had been enabled to work out the affinities of *Eozoon* more accurately, and was disposed to regard it as of a rather higher type of Foraminiferal organization, considering that it had points in its structure found in three existing orders of the Foraminifera. The identification of the fossil turned upon minute structural differences, which could not be explained in a short report, but which were made evident by a series of drawings and preparations lent to Mr. Carpenter by his father. A vertical section of the fossil showed the calcareous shell, the parts occupied by the animal when alive being filled with a kind of serpentine. Since its discovery in Canada it had been found in Ireland, the recognition depending upon structure only to be seen with the aid of the microscope.

III. March 2; Mr. W. Sanders, F.R.S., in the chair.—It was announced that a Zoological Section had been formed, open to all Members of the Society, on payment of the usual Sectional Subscription, to meet at half-past seven in the evening on the first Wednesday of every month, except the four summer-months. Mr. B. N. Lobb spoke on *Aquariums*. Mr. T. G. Ponton read a paper *On the Functions of the Foot of the Conchifera, or Bivalve Molluscs.* —*Bristol Daily Post.*

Newcastle Natural History Society.—At the Fourth Winter Evening Meeting of the season, Feb. 17th, Mr. H. B. Brady, F.L.S., delivered an address '*On the Lowest Forms of Animal Life.*' The chair was taken by Professor J. H. M'Chesney. Mr. Brady commenced by giving, with much interesting detail, an account of the numerous objects revealed by the microscope amongst the lower forms of animal life. His descriptive remarks were much assisted by a number of large drawings of the objects referred to. He then passed on to a notice of Sponges, showing the extent of our knowledge of the functions of these singular forms of animal life, and giving a number of interesting facts in connection with them, which the investigations of scientific men had brought to light. The Sponges on our own shores and their habitats were described. Comparatively recent investigations in this department of natural history have led to the discovery that perforations in shells and the 'holey stone' found on our shores—regarded by the superstitious as obnoxious to witches—are the work of a singular form of Sponge. Some recent and interesting discoveries in Foraminifera were then touched upon, and Mr. Brady exhibited some novel fossil specimens which had been discovered by the late Mr. W. K. Loftus, of this town, while in Persia. In illustration of the minute size of some forms of Foraminifera, the Lecturer stated, it was calculated that a square inch of chalk contained a million of them. In conclusion, the Lecturer mentioned that Foraminifera had been discovered in the Laurentian rocks of Canada in a horizon several thousand feet below the Silurian strata, which were previously supposed to be the lowest in which remains of animal life existed.

THE WIGAN FIELD-NATURALIST AND SCIENTIFIC SOCIETY held a Soirée on February 2nd, in the Public Hall, decorated for the occasion, and opened at seven o'clock. A large collection of objects of scientific and general interest was exhibited, comprising Aquariums, Microscopes, Photographs and Stereoscopes, Herbariums, Preserved Animals, Fern-cases, Hothouse Plants, Models, Scientific Instruments, Chemical Products, Miscellaneous Curiosities, and some Coal-fossils. The last were lent by the Mining School; the other numerous and various specimens were contributed by Members and friends. Music and refreshments were supplied at half-past eight o'clock. The President, Mr. E. H. Birkenhead, called on the Hon. Sec., Mr. Beruish, to read the Report of the Proceedings of the Society since its formation nearly three years ago. During the season 1863–4 five Excursions were undertaken, and in the past season there were four. Some of these excursions were largely, and others poorly attended; but all were successful in a naturalist's view, as on every occasion something new was observed, some new specimen collected. Eight evening-meetings have been held, at which papers were read. On each occasion the subject of the paper was freely discussed, and by this means afforded considerable information as well as interest. The Society has, during the past year, added 'Scientific' to its title, and increased the field of its researches, affording to its Members an opportunity of considering those scientific operations with which this neighbourhood abounds. Another series of Excursions will be commenced in the ensuing spring, when it is hoped that, as the Society becomes better known, its ranks may become stronger, and its Excursions and Meetings better attended. The President then delivered a lengthy and interesting address, in which he spoke of the objects of the Society, and pressed its claims upon the notice of the Meeting. He referred to the progress of Science, and touched upon the chief of the recent discoveries. In the geological portion of his address, he referred to the formerly accepted theory that the world is but 6,000 years old, and said that investigations had proved that it must in all probability be tens of thousands. He quoted several works on this point in substantiation of the argument, and urged that the study of Geology should enter more largely into the course of training at our Colleges for the Ministry, in order that students might be able to apply the light of its great truths to their teachings. The President next dwelt upon the question of the origin of species; and, having adduced several existing theories thereon, including that of Darwin, remarked that the degree of similarity which was found to exist between man and the lower animals was to him additional evidence to that already given of the unity of creation. He spoke next in support of the principle of free discussion as the only way to elucidate truth; and, having adverted to the vast assistance that the inquirer might obtain from the study of the physical world—a study to promote which was the chief object of the Society,—he concluded an admirable speech by observing, that if the meeting induced any one to take up the study of a single branch of Science, he was quite certain the promoters would be amply rewarded.—Addresses were delivered by the Rev. G. Hoadle, J. Leyland, Esq., the Rev. J. Cronshaw, and M. W. Peace, Esq., who, after his remarks, exhibited the newly discovered magnesium-light successfully. The visitors then dispersed for a further examination of the collections, and the proceedings closed at about half-past ten.—*Wigan Newspaper.*

HULL LITERARY AND PHILOSOPHICAL SOCIETY.—At the Fortnightly Meeting, on Feb. 14th. the President, Dr. KELBURNE KING, said that the Council had been for some time considering in what way they could best fulfil two important objects: first, how they could promote the prosecution of Science, both among their own Members and the inhabitants of the town, in a more practical way than hitherto; and in the second place, how they could render their admirable Museum useful to the community at large. In October, a Sub committee was appointed to take these matters into consideration, and, after due reflection, that Sub-committee brought forward a series of resolutions, which had been adopted by the Council.—(1) That it is desirable that Sections be formed in connection with the Literary and Philosophical Society, for the practical study of different departments of Science. (2) That any twelve Members desiring to study a particular branch of Science may form themselves into a Section for that purpose. (3) That each Section shall elect its own Office-bearers and be governed by its own Bye-laws, the latter subject to the approval of the Council. (4) That each Section shall be entitled to elect as Associates persons who are not Members of the Literary and Philosophical Society, such Associates having none of the privileges which belong to Members of the Society except in so far as the operations of the Section to which they belong are concerned. (5) The Sub-committee recommends to the Council to permit the use of its rooms, museum, and book to such Sections as may hereafter be formed, for the purpose o illustrating their Meetings; but that no book be removed from the building, and no specimen from its case, without special permission from the Council.—The President called their attention more particularly to the extreme liberality with which the Counci had acted in this matter. He could conceive nothing more likely to extend the practical study of Science in this town. He hoped sincerely that this movement which the Council had started would be followed out by the Members, and that they would see many Sections rising up in connection with the Society. He was fortunately in a position to say that the wish which had been expressed by the Council had been acted upon by a certain number of Members and that they had already one Section in full operation. A short time ago a few gentlemen met, and formed themselves into a *Geological Section*, which now consisted of 24 members (including seven who are not Members of the Society). To that Geological Section he wished particularly to call their attention, because it exemplified the principles for which their Council had contended. A mere nomina sum of half-a-crown and five shillings would be charged to Members and Non-members respectively. The Society would open its rooms to all who were anxious to embrace the study of any Science. The President then called upon C. C. Blake, Esq., F.G.S., Secretary to the Anthropological Society of London, to read his paper *On the Lowest Races of Mankind.—Hull Times.*

Dumfriesshire and Galloway Natural History and Antiquarian Society.—This Society, which is now in its third year has made rapid progress. The number of Members is now nearly two hundred, including a great part of those residing in the South of Scotland who have a Scientific or Literary taste. Meetings are held during the winter on the first Tuesday of each month, in Dumfries; and during the summer there are Monthly Excursions.

I. At the Fourth Meeting of this Session, Sir W. Jardine, Bart., in the chair, the Chairman first made a very interesting communication on the finding of that rare British Bird, the Roller (*Cracius garrula*) near Dumfries. Sir William also exhibited a number of specimens of Birds allied to the Roller from various parts of the world.—Dr. Gilchrist then read a detailed account of the geological observations made during the Excursions of the Society last summer.—Dr. Grierson then gave an account of the genus *Arvicola*, or Vole, exhibiting a series of specimens of strange varieties; and he described the ravages that had been committed on the plantations in the Drumlanrig Estate by two species, *A. agrestis* and *A. pratensis.* Dr. Grierson also exhibited a strange abnormal formation of a pig's foot, which led to a lengthened discussion.—A number of Donations to the Library of the Society were laid upon the table.

II. March 7th; Sir W. Jardine, Bart., in the chair. At this (Fifth) Meeting of the Society, after Donations had been presented,

Mr. W. M'Diarmid read an interesting extract from the old Burgh Records of Dumfries, 1745. Dr. Grierson then read a paper on *Relics of Pre-historical Man in Nithsdale*, as illustrated by a selection of stone celts, spear-heads, and other implements, some of which he regarded as of local, and others of foreign and superior workmanship; the latter possibly belonging to an invading race.—From the *Dumfries Herald*.

The Winter Meeting of the **Warwickshire Naturalists' Field-Club** was held in the Museum, Warwick, by the kind permission of the Council of the Natural History Society, at twelve o'clock on Tuesday, 14th of February, 1865. The President, Wykeham Martin, Esq., M.P., having taken the chair, called upon Mr. Parker to deliver his promised Lecture *On the Bone-Caves of Liége*, which he had recently visited. Having described them in detail, he declared himself unable to discover the force of Sir C. Lyell's arguments respecting the great antiquity of their contents, from the physical aspect of the neighbourhood, and from the presence of remains of extinct animals. It was clear, he thought, that their contents had been introduced at different periods. He contended that the Bear was coeval with Man as well as with the Rhinoceros; but the argument for the coexistence of the latter alone with Man he thought to be very imperfect. Considering the way in which these caves have been filled, he thought that the fact of the remains of Man being found under the conditions detailed by Sir C. Lyell would not appear extraordinary, nor afford evidence of very great antiquity.

The President then read the Proceedings of the Club during the past year, in lieu of the usual Address customary on this occasion, with a few prefatory remarks on the prosperous condition of the Club, but urging a better attendance at the ordinary Field-meetings. He then called upon the Rev. P. B. Brodie to read his paper *On three Liassic Outliers in Shropshire, Staffordshire, and Cumberland*. It was pointed out that some outliers had been deposited independently, though contemporaneously, while others, once connected with the main mass, had been afterwards denuded. In the Shropshire outlier, the fossils, though belonging to different zones, are in most respects identical with well-known Liassic species, but a few are peculiar to Germany and Scotland—a fact worthy of notice. This outlier is ten miles long by six broad; but the Drift, for the most part, conceals the underlying stratum, and few sections are now exposed. This is the case also in Cumberland. In Staffordshire the lowest beds of the Lias (Rhætic) are exposed near Needwood Forest, and present a section and fossils similar to those of the outlier at Copt Heath, near Knowle, already described. The Cumberland outlier, long supposed to be Mountain-limestone, belongs evidently to the Lima and Saurian beds of the Lias. The chief point of interest is to decide whether these were originally detached outliers, or connected with the chief range of the Lias. The first two are not so very far apart in a straight line, while the latter is nearer to the same formation in Ireland, near Belfast, which was next described.

as well as some patches in Scotland, near Elgin and at Skye. At all events, these remnants of Lias, now separated from the main mass in Shropshire, Staffordshire, and Cumberland, are well worthy of notice, presenting many features of interest, and deserving a careful and detailed examination.

The Meeting then adjourned. Owing to the severity of the weather, there was not so good an attendance as usual, though about forty persons were present, including some of the Dudley Field-club and several ladies, who were especially invited on this occasion. The interval between this time and dinner was filled up by (1st) an inspection of the Museum, which has been lately renovated and enlarged, many important additions having been made to the excellent Geological and Zoological collections; and (2ndly) by a walk to the Lower Keuper quarries at Coten-end. All matters of business were transacted after dinner, when the President and Vice-president were unanimously re-elected, and the Meetings fixed for the ensuing summer.

THE COTTESWOLD NATURALISTS' FIELD-CLUB held its Nineteenth Annual Meeting at the Bell Hotel, Gloucester, on the 29th March. Major GUISE was re-elected President, and Dr. PAINE Secretary. The Meetings for the Season are—*Stroud*, 24th May; *Chepstow*, 21st June; *Bradford Abbas*, 19th July; *Tortworth*, 16th August; *Beckford*, 27th September.

The President read the Annual Address, which gave an excellent epitome of the work done by the Club during the past year. He then read a translation, by Mr. John Jones, of Dr. EDOUARD DUPONT's Report to the Minister of the Interior at Brussels, on the Scientific Excavations made in the Province of Namur during the year 1864. This able document contained some interesting statements relative to the Bone-caves of the Province of Namur, which had formed the subject of Dr. Dupont's special study. The species of Mammals had been determined by M. Van Beneden. He found different parts of the skeleton of the Reindeer, and 150 antlers of this species; most of them had been broken by the violence of the water, which had brought boulders into the cavern; but many were well preserved. Bones of the Glutton, Bear, Chamois, Elk, Stag, Fox, Wolf, Horse, Ox (*Bos primigenius*), Ibex, Field-mouse, and 'le Coq de bruyères,' with fifteen other species, were found in these caverns. A number of the remains of human industry have been exhumed from amongst this ancient fauna, so foreign to the actual condition of the province; these consisting of worked flint implements of different kinds, and bones rudely carved, and formed into tools of various kinds. Other caverns contained the bones of ancient human races. All these relics will form the subject of a special memoir.

After a capital dinner, at five o'clock, M. ETHERIDGE, F.G.S., Palæontologist to the Geological Survey, read an interesting paper *On the Avicula-contorta-beds at Garden Cliff, near Westbury-on-Severn*, which he illustrated by some beautiful sections made by

Mr Bristow and himself during the [illegible] different parts of the [illegible] of the *Avicula-contorta* [illegible] with others in different [illegible]

Dr Wright [illegible] the Cotteswold Naturalists' [illegible] their [illegible] Transactions [illegible] contained in several of the [illegible] out; for the fossils [illegible] fragmentary [illegible] and dried on the [illegible] Although Mr Etheridge had given a fair [illegible] the views entertained by many of the authors who had written on these beds in this country, still it was right to state that there was a great division of opinion as to whether the Avicula-contorta [illegible] should be grouped with the Trias or with the Lias. In his able Monograph on the 'Contorta zone' Dr. Dittmar had shewn that among [illegible] geologists who had made this zone a special study, and the list included some of the most eminent of living naturalists, 18 referred these beds to the Keuper, 21 [illegible] them to the Lias, and 12 were undecided as to which formation they should be grouped with.

The President then read a short report by Mr James Buckman *On some Flints [illegible]* [illegible] remarks by Dr. Henry Bird [illegible] which accompanied the paper and [illegible] other Cotteswoldians in their researches [illegible] T.W.

Richmond and North-Riding Naturalists' Field-club.—A General Meeting of the Members of the Richmond and North Riding Naturalists' Field-club was held in the Magistrates' Room, in the Town-hall, Richmond, the 14th of March, for the purpose of electing officers for the ensuing year. The following were appointed:—President, E. Wood, Esq., F.G.S.; Vice-presidents, the Rev. R. F. Roberts, Rev. James Tate, Lonsdale Bradley, Esq., F.G.S., James Ward, Esq., F.B.S. Edin., J. Bowe, Esq., R. Bowes, Esq., T. Thompson, Esq., F. Sanderson, Esq.; Treasurer, C. Other, jun., Esq.; Secretary, Mr. James Aspdin. After some preliminary discussion, a question arose as to the ownership of the Museum, whether it was in the power of the trustees or the committee in management. This matter, however, was left over for further consideration. E. Wood, Esq., F.G.S., then rose and said: 'Gentlemen,—On taking the chair on this our opening meeting, a few words as to the future of our infant Club may not be inappropriate. As stated at a preliminary gathering, I accepted the honour of the presidential chair with great reluctance, but I already feel at home in my position, and most hopeful for the success and well-doing of our Club. I know that on my asking for a hundred pounds to start with, many of my neighbours thought the sum so large that our success was quite hopeless. I must admit having had some fears myself on the subject; but they are now happily dissipated, and I feel and know that we are on the eve of forming a truly beneficial Society. Almost without an effort or solicitation, we have about half the number of the twenty £5 patrons; and at the head of that list stand the names of that distinguished noble family, whose liberality and patronage for everything good in this district is never asked in vain. We fully hope for the co-operation of the other leading families, to stimulate us to success in the future. Upwards of eighty Annual Subscribers are already booked; and it is fair to expect we can double that number. We ought indeed to be proud and thankful for such real and gratifying liberality. Our only remaining difficulty now appears to be the want of rooms; and I think this Meeting will agree with me, that it will be desirable to enquire about and advertise for such. We ought to have one large room (if with sky-lights, so much the better), and a smaller one for packing and unpacking. These rooms ought not to be detached, but ought to form part of an establishment, where a resident Housekeeper would be ready to keep at proper and stated times. We will expect the occupation to be temporary, as I am hopeful to see an appropriate building for the purpose in some of the beautiful situations around us. As soon as our room gets its contents, our path appears to be easy. Few districts are so rich in objects of scientific interest as our own, and it will be our duty, and, I trust, it will likewise be our work, to induce many of our good sons and fair daughters to study God's handiwork in that patient, humble, loving, and reverent spirit which alone can read its teaching truly and wisely. Our primary object must be to instruct, not to amuse. Our Summer Field-meetings will doubtless prove objects of real instruction and enjoyment: with such guides as Mr. Ward for Botany; as Mr. L. Bradley for Mineralogy; and I may venture to add, as your President for Geology and Ornithology, these gatherings must be of a most enjoyable nature. I have already made some provisional arrangements for a grand day's trip to one of the Durham Coal-mines, where it will be my duty to point out the nature and formation of Coal, and to exhibit, perhaps down the pit, the wonders of its workings, and of the large and busy hive of its industry. Mr. Bradley will give a similar trip to one of his Lead-mines in Swaledale; and Mr. Ward will arrange for a botanical field-day in the classic district around the Round Howe. We likewise hope for many short evening-excursions around our town during the long days, starting at seven, returning at ten. As long as I am president, I pledge myself to do everything in my power to keep the whole arrangements of our Club to the six working days of the week. It is possible some one may say, on looking over our cabinets of objects of Natural History, "What a destruction of life!" Now really this will not be the case. I do not believe that a really good naturalist can be a bad man,—the true lover of nature admires all created things; he knows how wonderfully they are made, and he shrinks with loathing and with dread from their useless destruction, and from the very wantonness with which the humblest of God's created things is constantly destroyed.' After a vote of thanks to the worthy President, the Meeting adjourned.—*Richmond Herald.*

The Members of the Malvern Field-club held their Annual Meeting for the election of Officers, the audit of accounts, &c., at the Museum of the Society, at Malvern, on April 5th. The Rev. W. S. Symonds, of Pendock, was re-elected President; Edwin Lees, Esq., Vice-president; and the Rev. R. Pindar Hill, Hon. Secretary. The places of Meeting for the ensuing season are as follows:—*May*—The Lickey Hills, near Bromsgrove. *June*—Cleobury-Mortimer. *July*—Lower Lode, Tewkesbury. *September*—Birmingham, for the Meeting of the British Association, with a Field-meeting at Malvern after the British Association Meeting. The Club voted the sum of £10 to the President and a Committee, for the investigation of certain Drift Deposits in the district; and £5 to Mr. Lees for the opening of a tumulus in the neighbourhood of Malvern.—W. S. S.

CORRESPONDENCE.

To the Editor of the Geological Magazine.

Sir,—With reference to the Article in No. IX. 'On a sudden Sinking of the Soil in a Field at Lexden in Essex,' by the Rev. O. Fisher, I wish to offer a few suggestions. The sinking occurred in 1861; and in 1862 I visited the spot and examined it carefully. It corresponds exactly with Mr. Fisher's description with one exception, which may or may not be of importance in the explanation of the formation of this curious pit. He has omitted to state that on one side of the pit, the earth has not quite subsided on a level with the floor, but rises in a rather abrupt bank. At least it was so when I visited it, which was nearly a year prior to Mr. Fisher's visit; and perhaps during that time alterations might have taken place, or some of the soil been removed.

I here give a rough section I made immediately on my return home.

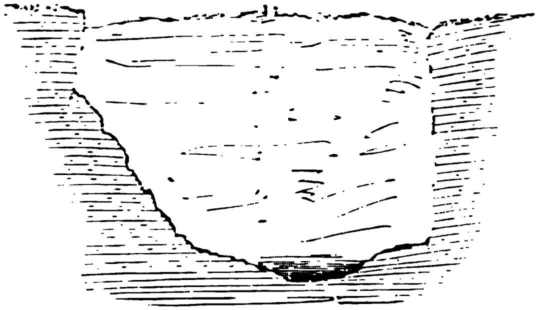

Fig. 1.—Section of the Natural Pit at Lexden, in 1862.

Mr. Fisher says, 'That there must be a vacuity somewhere beneath the subsidence is clear. That it should be in the gravel is impossible, because the stratification, as exposed in the sides of the hole for about 10 feet, is perfectly regular; that it exists in the London Clay is also impossible; but that such a cavity should exist in the Chalk is probable.' Now I would wish to question Mr. Fisher's explanation with all humility, as I am but a very young hand at Geology.

The author of the article then proceeds to state, that wells have been bored in the neighbourhood, at distances of a mile or more from the pit; and he continues, 'I conceive, then, that the motion of the water in this subterranean reservoir' (in the chalk at a depth of nearly 300 feet), 'caused by the draught of water at these wells, disturbed the equilibrium of the roofing of the chasm at a point where it was barely stable, and caused the subsidence in question.' I would suggest, if the cavity at this depth were large, why did not a larger area subside?—and, if small, surely it would not cause a roof of from 200 to 300 feet thick to sink. The explanation that I would suggest, would rather be, that erosion has taken place in the Low-level-gravel at a small depth below the pit, say 20 feet or a little more (allowing an inequality in the thickness of the bed of gravel, which at the well a mile distant was found to be about 12 feet), and that, when this erosive action had sufficiently undermined, the roof fell in.

I might better explain my ideas by the following section (hypothetical).

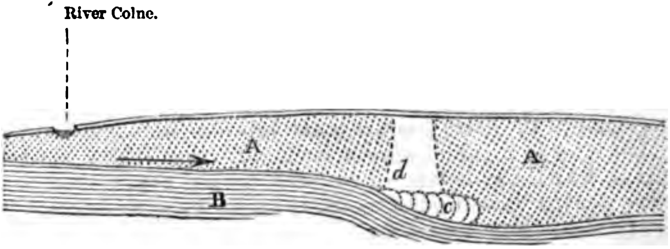

Fig. 2.—Diagram to explain the Formation of the Pit.

A. Low-level-gravel.
B. London Clay.
c. Dotted lines to show successive stages of erosion.
d. Point at which the débris would (and did) stand highest.

The erosion would have been either from water from the River Colne, or from rain having percolated the gravel and run down an inclined surface of the clay at its junction with the gravel.—Yours, &c.,

FRANK RUTLEY.

13, DENBIGH PLACE, S.W.

THE BURNING WELL AT BROSELEY.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—As I did not perceive any reply in the last Number of the GEOLOGICAL MAGAZINE to the enquiry in the previous Number relative to the Burning Well at Broseley, mentioned in some old topographies, I have ventured to give very briefly the information required.

The so-called burning well has ceased to exist for nearly a century. It was fed by a spring; and petroleum and naphtha also found their way from rents in the rock into the well with the water, and were occasionally ignited. Springs of petroleum, on a much larger scale than the Broseley one, are met with in the neighbourhood, and the yield of each of these was formerly much greater than at present. Many hogsheads from one of these were exported some years ago, under the name of 'Betton's British Oil.' The rocks were tapped by driving a level through one of the sandstone rocks of the Coal-measures; but these are now drained, and very little is found to flow from them. This is also the case with a spring in Tar-Batch Dingle, about a mile and a half lower down the Severn; the tar-spring is still to be seen, but the quantity given out is smaller, we apprehend, than when it first gave its name to the Dingle.

With regard to its origin, it is well known that many of the trees of the Carboniferous period were resinous, like our pines; and it is easy to suppose that the oil pressed out from the accumulated masses of vegetable matter which formed the coal-seams would become absorbed by the sand-beds above them, and that this oil would naturally find its way out when tapped by shafts, or levels, or water-courses.

JOHN RANDALL, F.G.S.

MADELEY, SALOP, *April* 14, 1864.

ARE THE SLATE-ROCKS OF CHARNWOOD FOREST LAURENTIAN?

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—In the last number of the GEOLOGICAL MAGAZINE, Sir R. Murchison, in his paper 'On the Laurentian Rocks of Great Britain, Bavaria, and Bohemia,' brings prominently into notice the *strike of the beds* of the old rocks of the North-west Highlands 'fundamental gneiss' as being a feature distinguishing them from the Cambrian and other aqueous rocks of our Island. It may be useful to notice that the *old slate-rocks* of Charnwood Forest have precisely this same *strike*, viz. S.E. by N.W. These rocks, covering an irregular square of about ten miles, have been doubtfully, I think, classed as 'Cambrian.' They have many features that distinguish them from the 'typical Cambrians' of the 'Longmynd;' among these may be noticed the great variety of rocks,—four species of so-called igneous rock (Granite, Syenite, Greenstone, and Basalt*),—almost every variety of slate, from coarse-grained grauwacké to fine roofing-slate,—the remarkable *metamorphic* character of the whole group; slate passing by insensible gradations into greenstone, and the occurrence of gneiss in almost close contact with granite; there are also some beds which may turn out to be altered limestones; and then, this group is really an *old mountain-chain*, having an anticlinal line, which (if the beds had not been broken through and broken up at the same time) would have given a ridge of many thousand feet high. These features, I think, distinguish this group of rocks from the Cambrians of Wales.

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* I have part of a fine hexagon from the artificial lake; it is a coarse-grained basalt.

JAMES PLANT.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—In your last Number, under the head of 'Proceedings of the Glasgow Geological Society,' a paper is reported to have been read 'On the Discovery of Lower Carboniferous Fossils in the Upper Coal-measures;' and it is stated that they were discovered 'higher in the Carboniferous series than previously known.'

I beg to state that this is not the first discovery of marine forms in the Upper Coal-measures. They were discovered, several years ago, by Messrs. Hull and Green, of the Geological Survey, at Ashton-under-Lyne, in Upper Measures. Shortly afterwards, I had the good fortune to discover them in the upper part of the North Staffordshire Coal-field.—I am, &c. JOHN WARD.

25, STAFFORD STREET, LONGTON,
STAFFORDSHIRE.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—I enclose some samples of a mineral I discovered about a year ago in some clay-land I have near the Humber-side at this place. I had a quantity of the clay dug, with a view of finding out what fossils it contained at a lower depth than it is common to dig it out for the purpose of making bricks. The clay at the surface is brownish in colour, but gradually becomes blue as you go lower, and at about ten feet deep is nearly black, very 'sludgy,' and apparently contains a great deal of vegetable matter. At about seven or eight feet I took a lump of the clay, and, kneading it in my hand, felt something prick me: I found what looked like small twigs, of from half an inch to an inch long, and varying from about the thickness of an average pin, to three or four times that thickness—but evidently iron or metal of some kind. I tried it with the magnet, and found it flew to it at once. I have since found that it is itself magnetic, and that when slightly filed it will attract small steel filings. I showed a sample of it to Dr. Percy several months ago; and I understood him to say that the 'structure' was new to him, but that he would make some enquiry about it; but as I have heard nothing from him on the subject, I presume he has forgotten all about the matter. I have therefore thought it my best plan to write this letter to you, thinking that either yourself or some of your many readers and contributors may perhaps kindly favour me by saying whether it is usual to find in such a place such a mineral.—I remain, &c.,

ALFRED HENRY PECHELL, Barrister-at-law.

BARTON-ON-HUMBER: *Feb.* 18, 1865.

THE COAL-BASIN OF NEW SOUTH WALES.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—By the Australian mail, just arrived, I have received a letter from my friend, Mr. JOHN MACKENZIE, Examiner of Coal-fields to the Government of New South Wales, from which I extract the following (Mr. Mackenzie is stationed at Wollongong):—'I have had a journey of upwards of 300 miles for the purpose of seeing whether the *Hartley Coal-seams*, in the County of Cork, belong to the same Coal-basin as that of Newcastle and Wollongong; and to see if I could find out with which known seams of coal on this side they were identical. I was able to recognise them. Another reason for my going was, that I had an idea that I could find coal identical with the *Fitzroy Coal* at a distance of thirty miles from Sydney, the metropolis of New South Wales. I have satisfied myself that coal will be found there; but I must make another examination before I can tell whether there is a good seam of coal. I have found the lower coal, which is inferior; and I cannot yet tell whether it will be near enough from the edge of the Coal-basin for the next excellent seam of coal to come in above it. The Coal-measures I find gradually increase in their thickness from the edge of the Coal-basin towards the centre; and the Sydney, or Clarke's "Hawkesbury," Sandstone rests on the Coal-measures near the edge of the basin; whilst, near the centre of it, it is 900 feet from the top coal; sandstones and shales, different in nature from the Hawkesbury Sandstone, intervening in the 900 feet. It has been supposed by other geologists that it would always be from 900 to 1,000 feet from the Hawkesbury Sandstone to the first coal; whilst I am certain that I can find it, only thirty miles from Sydney, at a depth of from 150 to 200 feet. But if I go to twenty-eight miles, and find the top coal coming in, it might be 400 feet.' After giving an account of the great difficulties attending the exploration, Mr. Mackenzie continues:—'I will first give you an outline of what I know from my own exploration of this vast coal-field. I have explored the Counties of Canada, Cumberland, Cork, Hunter, Northumberland, and Durham, and find that the New South Wales Coal-basin extends under the whole of them, and a portion or the whole of Gloucester (I have not explored the whole of it), as well as a portion of the counties of Brisbane (*not* Brisbane in Queensland), Phillip, Roxburgh, Westmoreland, and St. Vincent; and that the south-easterly and easterly side of the coal-basin lies partly buried under the Pacific Ocean, and principally washed away. This makes the New South Wales coal-basin at least 200 miles in length, and probably the same in breadth: but the breadth can never be ascertained, owing to the easterly side of the basin being in the Pacific Ocean.'

I have given the above in Mr. Mackenzie's words: it is at your service. Mr. Mackenzie was the discoverer of a magnificent seam of coal (12 yds. or more) in New South Wales, not long since.*—I am, yours truly, E. H. BIRKENHEAD, B.Sc., F.G.S.

WORSLEY MESNES, WIGAN: *Feb.* 24, 1865.

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* See GEOLOGICAL MAGAZINE, No. V. p. 234.

ON A BED OF LOWER BOULDER-CLAY AT HEATON MERSEY, NEAR MANCHESTER.

A CORRESPONDENT, who has lately given a good deal of attention to a bed of Lower Boulder-clay in Mr. Thorniley's brick-fields at Heaton Mersey, and which is called by the workmen 'red shaly marl,' writes thus :—

'The only published notice I have seen of it is in a memoir "On the Geology of the Country around Oldham, including Manchester and its Suburbs," by Mr. Edward Hull, in which he gives the following section :—

1. Fine white sand, laminated; two feet.
2. Layer of peaty matter, composed of the stems and branches of a tree with a shining bark, either Birch or Hazel; three inches.
3. Dark-brown, fine, laminated clay, without pebbles (warp?); five or six feet.
4. Boulder-clay, with striated pebbles; five feet.

Both the sections to be seen there now are rather different. The first is from the principal pit:—

1. White or silver sand ; one foot.
2. Bluish clay, perhaps the Upper Boulder-clay, stratified and unfossiliferous; six feet.
3. Red sand and gravel; nine inches.
4. Lower Boulder-clay, or 'red shaly marl;' seven feet.
5. Trias; forty-five feet seen.

The next section is from one of the smaller pits :—

1. Boggy soil, with branches of trees, most probably Birches; three feet.
2. Bluish clay, like No. 2 in the above section; four feet.
3. Trias; forty-five feet seen.'

Our Correspondent adds, that some fossils, derived from the Carboniferous rocks, such as fossil Fish, a fossil Fern (*Alethopteris?*), and *Producta Martini* (in limestone), have been found in this particular clay-bed. Other fossils shells are said to have been formerly found, and a Birch-leaf (possibly, however, from an upper bed). Nothing has been found lately.

MISCELLANEOUS.

◆

NOTES ON NEW MINERALS, BY PROF. A. C. CHURCH, F.C.S.

THE HYDROUS MINERAL PHOSPHATES.—Some of the hydrous mineral phosphates have been lately studied by Professor Church, and his results have appeared in the 'Chemical News,'* under the heading 'Revision of the Mineral Phosphates.' The following are the chief conclusions at which Professor Church has arrived :—

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* 'Chem. News,' vol. x. 1864, pp. 145, 157, 217, 290.

Delvauxite.[*] – This mineral, when free from hygroscopic moisture, has the formula Fe_2PO_4, aq. + $Fe_2H_3O_3$, which demands 16·31 p. c. H_2O: experiment gave 16·9 p. c. Delvauxite dried at 100° has the formula $Fe_2PO_4 + Fe_2H_3O_3$, which demands 10·46 p. c. H_2O: experiment gave 10·97 p. c. The delvauxite analysed was from Liége, Belgium, and contained no calcium compounds.

Dufresnite.—This mineral when perfectly pure has the formula $Fe_2PO_4 + Fe_2H_3O_3$, which requires 10·46 p. c. H_2O: experiment gave 10·55. In fact air-dried dufresnite has the same composition as delvauxite dried at 100°.

Prasine.—Pseudomalachite or prasine generally contains some malachite, together with other impurities; when due allowance is made for these intruding compounds its formula, like that of phosphochalcite, is $Cu_3PO_4 + 3CuHO$. Dihydrite (and perhaps ehlite also) has the formula $Cu_3PO_4 + 2CuHO$, while the composition of libethenite (and possibly of pseudolibethenite and tagilite also) would seem to be represented by the expression $Cu_3PO_4 + CuHO$.

Calaite.—The formula assigned to turquoise has scarcely been sufficiently supported by analysis. Mr. Church analysed a blue specimen from Nichabour, Persia, and after deduction of 10·47 per cent. of hydrated phosphate of copper (Cu_3PO_4, aq.) and 4·89 per cent. of hydrated ferroso-manganous phosphate ($3(FeMn)_3PO_4$, aq.), the analytical results closely correspond to those required by the formula $Al_2PO_4 + Al_2H_3O_3$.

A NEW MINERAL OF ORGANIC ORIGIN.[†]—*Tasmanite.*—In the Tasmanian Court of the International Exhibition of 1862, a 'resiniferous shale' was exhibited by the Dysodile Company. On examination and analysis, the combustible matter of this shale proved to be different from the true dysodile both in physical and chemical characters. It occurs in discs (·03 inch in diam.) disposed in planes parallel to the laminations of the shale; these discs are translucent, reddish-brown: lustre resinous, and fracture conchoidal. The density of the mineral is about 1·18; its hardness 2. The mineral, to which Mr. Church gives the name Tasmanite, is unaffected by alkalies and most solvents of organic resinoids: its chief chemical characteristic is the large amount of sulphur in organic combination which it contains. Numerous analyses of tasmanite gave these results as a mean—

Carbon	72·88
Hydrogen	9·56
Sulphur	4·90
Ash (*a*)	8·14 (*b*) 12·24

Making due deductions for the ash of the specimens, these numbers correspond to the following corrected percentages:—

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[*] In this and the four following notices Gerhardt's notation is adopted: – C = 12, O = 16, S = 32.

[†] Phil. Mag., Dec. 1864.

	Experiment.	Theory, $C_{40}H_{62}O_2S$.
Carbon . . .	79·34	79·21
Hydrogen . .	10·41	10·23
Sulphur . . .	5·32	5·28
Oxygen . . .	4·93	5·28
	100·00	100·00

The formula above given corresponds very closely with that usually accepted for some pure varieties of retinite, but the oxygen of retinite is here partly replaced by sulphur. In fact, tasmanite would seem to be the sulphide of the same radical of which retinite is the hydrate—

$$\left.\begin{matrix} C_{20}H_{31}O \\ C_{20}H_{31}O \end{matrix}\right\} S \quad \text{tasmanite.}$$

$$\left.\begin{matrix} C_{20}H_{31}O \\ H \end{matrix}\right\} O \quad \text{retinite.}$$

These minerals may be derivatives of a turpentine, $C_{20}H_{32}$; or the radical assumed to be present in them may be homologous with benzoyle, for $C_{20}H_{31}O = 13CH_2 + \underset{\text{Benzoyle.}}{C_7H_5O}$.

NOTE ON ANTIMONY-MINERALS FROM BORNEO.—*Native Antimony* is found in masses of various sizes, always coated with a thickish crust of cervantite (antimony-ochre). This native antimony is nearly pure; occasionally it is found associated with the sulphide of antimony, and, from this locality, is always of a very fine granular texture, sometimes very friable, and often tarnished.

Antimonite, or sulphide of antimony, is found massive in great abundance, large quantities being shipped, for smelting, to England and Hamburg.

Cervantite, or antimony-ochre, is found in very large quantities, hundreds of tons being shipped for smelting. This is derived entirely from the decomposition of the sulphide, in cavities of which sometimes terminated and acicular crystals of the original sulphide are found. On some of these altered crystals are found, but rarely crystals of *Valentinite*, in flat tables, usually coated with antimony-ochre.

Kermesite, or red antimony, is found only sparingly with the cervantite and sulphide, as a reddish powder. Native arsenic is also found associated with the antimony-ores from this locality.—J.R.G.

NOTE ON THE ANTIMONY-MINERALS FROM ALGIERS.—*Senarmontite* is found in three forms; namely, in transparent and opaque octahedral crystals,—as botryoidal incrustations, of a snow-white colour, and massive and compact, of a greyish colour. This mineral is worked largely at Ain-bebbouch, in Constantine, Algeria, as an antimony-ore, and is exported for smelting to this country in considerable quantities.

Cumengite, a variety of volgerite, is found in radiating fibrous masses, yellowish white to perfectly white in colour, in the province of Constantine, Algeria.—J. R. G.

Equisetum in Gneiss.—In a paper recently read before the Academy of Sciences of Turin, Professor A. Sismonda described a plant-like marking on a specimen of gneiss found in the drift covering the Liassic limestone occurring north of Rezzago in the Brianza. After remarking that he does not believe it possible that it should be of dendritic origin, he records the opinion of several distinguished botanists and palæontologists on the subject. Professors E. Sismonda, Bellardi, Gras, and Parlatore considered it to be a species of Asterophyllite (*Annularia*), while Brongniart referred it to a new species of *Equisetum*. The author then discusses the age of the metamorphic rocks of the Alps, and supports the opinion of M. Elie de Beaumont, that they are for the most part of Jurassic age. The specimen which is the subject of the paper he infers was derived from the Valtellina, and the gneiss of that mountain he considers of Infraliassic age. The paper is illustrated by a photograph of the specimen, showing very clearly the radiating leaves of the supposed *Equisetum*, and the gap left by the decay of the central axis.—H. M. J.

ON THE PRESERVATION OF FOSSIL MAMMALIAN REMAINS FOUND IN TERTIARY DEPOSITS.

By Mr. W. Davies, of the Geological Department of the British Museum.

Owing to the loose mineral character of the Tertiary deposits, in which most of the Mammalian and other vertebrate remains are found, consisting as these deposits chiefly do of sands, gravels, clay, or peat, their fossils are necessarily in a more or less friable condition, difficult to preserve entire, or to handle for scientific examination with safety. Hence, probably, a few remarks as to the method usually adopted for hardening and preserving them may interest, and be of service to, some of your readers who collect such fossil remains.

The substances generally used are glue or gelatine. For the bones of the larger Mammalia there is nothing better than the best glue; whilst for the more delicate bones of the smaller Mammals, Birds and Fishes, gelatine is the best, being purer, dissolving more easily, and imparting but little, if any, colour to the fossil. The consistency of these substances when used will have to be varied according to the structure of the bone; and as they also differ greatly in quality, it is impossible to lay down any definite rule as to the exact proportions to be used with a given quantity of water; this must be left to the judgment of the operator. As a general rule, however, all bones which have a coarse cellular structure, as the ends of large limb-bones, deer-antlers,&c., and also specimens from some deposits—for example, the peat-bed near Colchester, the fossils from which have their internal cellular structure either totally or partially destroyed—require the glue-solution to be of a consistency which will form a stiff jelly when cold; whilst for bones of a compact structure a much thinner solution, about the consistency of ordinary size, will suffice; If the solution is too thick, it clogs the absorbing power at the surface, and prevents its penetrating to all parts of the bone.

The fossils should be thoroughly dried and cleaned from as much of the matrix as can be removed with safety; and, if it can be managed, *warmed* before being placed in the solution. When the glue is all dissolved, and the liquid nearly at boiling heat (ebullition should be avoided, if possible), it is ready for the immersion of the fossils, and they should remain in it as long as air-bubbles rise to the surface; when these cease they will be sufficiently soaked. When taken out, they should not be drained, but laid in a position to retain as much as possible of the imbibed solution, until they are cold, when the glue will have set. Their position must then be shifted, to prevent their adhering to the board on which they may be laid. Any glue that may have drained from them may be then removed with a wet sponge.

The vessels required are of the simplest kind. The common domestic utensils will answer for most purposes. The ordinary house-copper, saucepan, or, better still, a large-sized fish-kettle with its strainer. But whatever the vessel used, a strainer of some kind, on which to place the bones for immersion and withdrawal, is indispensable; for the copper nothing is better than a wire-sieve. For bones too large for the vessel used, the treatment will have to be varied. For long limb-bones, strong enough to bear their own weight when saturated, it is only necessary to place one end in the vessel, and ladle the solution over the other end for a short time, and then reverse their position. But for bones which will not bear such treatment, the only plan is to securely fix them to a board, and place them in a slanting position in the solution, and well saturate them with it by ladling. For these, and for long portions of tusks of the Mammoth, and horn-cores of the large species of Bos, a special vessel, about three feet long, one foot wide at the top, nine or ten inches wide at the bottom, and nine inches deep, made of stout tin or galvanized iron, with a handle at each end, will be found most useful.

Occasionally fossils are found which are either too large or too friable (as skulls and tusks from their natural construction frequently are) to be placed in the solution : for these a different method must be adopted to preserve them entire. Cover the fossil with thin paper, over which—on the sides and underneath if possible—put a coating of plaster of Paris, just thick and strong enough to keep together; when firmly set, gently pour the solution boiling-hot over the fossil as long as it continues to absorb, to assist which it may be necessary to remove in a few places some of the surface-bone, which can be carefully replaced ; in two or three days the plaster may be partly removed by sawing and in small pieces, taking care not to injure the fossil by jarring it; the paper will prevent the plaster adhering to it. But this process is never so effective as submersion in the solution, and may require to be repeated. Some bones are better for being dipped a second time, but not allowed to remain long enough in the solution to melt the glue they had previously imbibed.

Delicate shells from the same kind of deposits may be treated, with care, in a similar manner with advantage.

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ORIGINAL ARTICLES.

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I. ON THE HISTORICAL EVIDENCE OF VOLCANIC ERUPTIONS IN CENTRAL FRANCE IN THE FIFTH CENTURY.

By the REV. T. G. BONNEY, M.A., F.G.S.

BETWEEN Bishop Colenso and the volcanoes of Central France, and between these and 'Rogation Days,' there would at first sight seem to be but little connection. Nevertheless, a statement made by the Bishop was the cause of some curious information, which had previously been known to but few, being generally circulated; and as it then appeared only in one or two newspapers, and at different times, it may be useful to give a *résumé* of the controversy in a more permanent form. The Bishop, referring to Lyell ('Elementary Geology,' pp. 197, 198), adduced the existence of cones of loose scoriæ and pumice in Auvergne and Languedoc as an argument against the Noachian Deluge; because these, which 'must have been formed ages before' that happened, did not show the slightest sign of having ever been disturbed. In the course of the endless controversy which has arisen from the Bishop's works, a Mr. E. L. Garbett addressed a rather angry letter to the 'Guardian' newspaper (Aug. 24, 1864), taxing the Bishop with wilfully shutting his eyes to the fact that there had been eruptions in these districts in the fifth century, which had given rise to the ecclesiastical fasts commonly called 'Rogation Days.' The Bishop replied in a letter, which was refused by the 'Guardian' on account of its length, and was afterwards published in the 'Daily News.' However, in the 'Guardian' of Sept. 14, a summary of it is given, in which the following statements are made: (1) that volcanic cones do exist as above described; (2) that, according to Hoffman's 'Lexicon,' Rogations were instituted owing to earthquakes and to the irruption of wild beasts into Vienne; (3) that there are no volcanoes near Vienne; (4) that the authors who are supposed to describe volcanic eruptions, only speak of earthquakes and ordinary fires, or perhaps of lightning. In the 'Guardian' of

Sept. 21, Archdeacon Phillpotts cites the two passages which he believes to describe volcanic eruptions; and the following week the Bishop replies, quoting, in defence of his views, a letter of Professor Ansted, and translating the passages given by the Archdeacon in his own way.

As it happened, I had at this very time just returned from a brief visit to Auvergne, and was engaged in investigating the same subject, quite unconscious of the debate then being carried on in the 'Guardian' and in the 'Daily News.' I venture, therefore, before quoting and commenting on the passages which appear to bear upon the question, to offer a few remarks upon the above-named correspondence, which I have only lately read.

Firstly, Mr. Garbett's objection does not invalidate the Bishop's argument, unless he can prove that *all* the cones of loose materials in Central France are 'post-Noachian.' This, I imagine, he would find it hard to do.

Secondly, Professor Ansted asserts that the 'whole of the volcanic phenomena (in Auvergne) are prehistoric,' that this is the opinion of the best geologists, and can only be set aside by fresh geological evidence. This statement appears to me to be also rather questionable. No one, of course, for a moment doubts that the *majority* of the phenomena are prehistoric; but it is impossible to prove that *all* are. Some of the cones of scoriæ, perhaps even some of the streams of lava, may have been ejected in comparatively recent times; and the question is really, except in one respect (to which allusion will presently be made), rather one for the historian than for the geologist. Besides this, the proof must extend to other parts of Central France.

The two passages which bear most directly upon the question are —one from a letter of Sidonius Apollinaris, Bishop of Clermont in Auvergne, about the year 460 A.D., to Claudianus Mamertus, who was Bishop of Vienne at the time of the supposed eruptions; the other from a homily on the 'Rogations,' written by Alcimus Avitus, Archbishop of Vienne.

The former, after describing the terror which an expected attack from the Goths was causing among his flock, goes on to say *—

> 'Our fears are soothed by the aid alone of the Rogations introduced by you, in the commencement and institution of which the people of Auvergne

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* 'Solo tamen invectarum te auctore Rogationum palpamur auxilio, quibus inchoandis instituendisque populus Arvernus, etsi non effectu pari, affectu certe non impari cœpit initiari, et ob hoc circumfusis necdum dat terga terroribus. Non enim latet nostram sciscitationem, primis temporibus harumsce supplicationum institutarum, civitas cælitus tibi credita, per hujuscemodi prodigiorum terriculamenta, vacuabatur. Nam modo scenæ mœnium publicorum crebris terræ motibus concutiebantur: nunc ignes sæpe flammati caducas culminum cristas superjecto favillarum monte tumulabant: nunc stupenda foro cubilia collocabat audacium pavenda mansuetudo cervorum: cum tu inter ista decessu primorum popularium que statu urbis exinanito, ad nova celer veterum Ninivitarum exempla decurristi, ne divinæ admonitioni tua quoque desperatio convitiaretur.'—Sidon. Apoll., Epist. lib. vii. ep. 1.

began to be initiated, though not with equal success, with certainly not unequal zeal; and for this reason does not even yet take flight from the terrors that encompass it. For it has not escaped our careful enquiry what kind of prodigies those were, owing to which, at the first institution of these supplications, the district placed by heaven in your charge was being deserted. For at one time the structures of the public buildings were shaken by frequent shocks of earthquakes; at another, fires often blazing were heaping over the tottering crests of the mountain-summits a piled-up mound of ashes; at another, the awful tameness of the deer led them to place their portentous resting-places in the forum: when thou, at this juncture, the cities being thinned by the departure of the nobles and of the people, swiftly didst betake thyself anew (to follow) the example of the ancient Ninevites, lest thy despair also should blame the Divine vengeance.'

The next passage is found in a Homily on the Rogations, by Alcimus Avitus, Archbishop of Vienne in the early part of the sixth century. After mentioning it as a cause for joy that these fasts, which had first been instituted in that city, had become so generally observed, he goes on to speak of the circumstances which gave rise to them [*]:—

'And, indeed, I know that many among us recollect the causes of terror at those times. Forsooth, frequent conflagrations, continual earthquakes, noises by night, used to threaten something awful for, as it were, the entombment of the whole city.'

He next mentions the unnatural tameness of the wild animals, that wandered about the town: then he proceeds to comment upon these things:—

'For who among frequent fires would not dread the fires of Sodom? Who among the elemental war would not fear that the mountains would straightway fall, or the earth open her mouth? Who, seeing (at any rate believing that he saw) deer, timid by nature, penetrating through the narrow gates to the open market-place, would not fear that the sentence of affliction was impending?'

Before making any remarks on these passages, it may be well to quote some expressions which occur in other old writers with reference to those times.

In the 'Chronicon' of Bishop Idatius we find (A.D. 451)—

'In Gaul were continual earthquakes, very many signs were shown in heaven.' C. 28 (Hist. Francorum Script., tom. i. p. 190. Paris, 1636).

In the year (apparently) after the Battle of Châlons (A.D. 452), we read that

'Certain things were seen in the heavens in the regions of Gaul at Eastertide. The letter of Euphronius, Bishop of Augustodunum, to Count Agrippinus, clearly mentions these.'

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[*] 'Et quidem terrorum temporis illius causas, multos nostrum adhuc recolere scio: siquidem incendia crebra, terræ motus assidui, nocturni sonitus, cuidam totius urbis funeri prodigiosum quiddam minitabantur. . . . Quis enim in crebris ignibus, ignes Sodomiticos non timeret? Quis trementibus elementis aut decidua culminum, aut disrupta terrarum imminere non crederet? Quis videns (certe videre se putans) pavidos naturaliter cervos per angusta portarum, usque ad fori lata penetrantes, non imminentem solicitudinis sententiam formidaret?'—Alcim. Avit. De Festo Rogat. Homel. (Monumenta S. Patrum Orthodox., tom. i. p. 1777. Bâle, 1569.)

Again, there were earthquakes and parhelia in 470.

Gregorius of Tours, speaking of the institution of Rogation Days by Mamertus, states that earthquakes were frequent at Vienne, that stags and wolves wandered about the city, and that the palace caught fire at Easter. G. T. Hist. Franc. ii. 34 (H. F. S. i. p. 289). He also (Id. p. 282) mentions another earthquake about the time of the death of Eoricus (King of the Goths); and in the fifth year of Childebert, A.D. 516, he describes a great flood in Auvergne, caused by twelve days' incessant rain, and an earthquake which was felt over the east and south of France. Tom. v. c. 34 (Id. p. 343).

In the 'Gesta Regum Francorum,' and the parallel 'Historia Francorum,' an earthquake and an incursion of beasts are mentioned in connection with the institution of Rogation Days (Id. pp. 703, 704); and in the 'Gesta Francorum Roriconis Monachi' (p. 811), we find an account closely corresponding with that in Gregorius of Tours.

From the above passages there seems a general *consensus* as to the occurrence of two phenomena,—earthquakes, and the entry of deer and other wild animals into the town. The former of these, as is well known, is common during volcanic eruptions; and the latter is recorded to have happened during the eruption of Coseguina in 1835 (Lyell's 'Principles,' p. 349, 9th edit.). The reference to the emission of flames and the ejection of ashes is certainly less distinct; but it is difficult to attach any other meaning to the words. It is indeed true that some take *culmen* to mean 'roof,' and translate the passage in Sidonius thus—'fires . . . heaped up the fallen ridges of the roofs with a piled-up mountain of ashes.' But though Sidonius is inclined to bombast, he scarcely seems equal to a flight like this, nor would he be likely to introduce a lesser between two greater prodigies. In the parallel passage in Avitus, the reference to Isaiah ii. 10, 19, 21, and Luke xxiii. 30, appears too clear to allow any other meaning than 'mountain-top' to be assigned to *culmen*. It then seems highly probable, so far as the historical evidence goes, that there were volcanic outbursts in Central France about the middle of the fifth century.

One difficulty, however, must be noticed in conclusion; namely, that of assigning the site of these volcanic eruptions. The mountains of Auvergne are too distant; as are most of those of Ardèche. It is, however, possible that one or two of the outliers of the latter, or some of the isolated vents about the upper part of the Loire, might be visible from the neighbourhood of Vienne; and it would be a useful episode in a visit to the Katakekaumene of Europe, to explore carefully the region between the Loire and the Rhone, in order to ascertain whether the meaning which, in the absence of direct negative evidence, certainly appears to be the most natural, is really the one which these old writers intended to be attached to their words.

II. NOTES ON SOME ECHINODERMATA FROM THE MOUNTAIN-LIMESTONE, ETC.

By JOHN ROFE, Esq., F.G.S.

[Plate VIII.]

1. *Actinocrinus.*

SEVERAL years since, when collecting Mountain-limestone fossils on the borders of Lancashire and Yorkshire, I found some specimens of *Actinocrinus* which appeared to have internal channels from the base of the arms towards the summit of the dome. Not having seen such channels noticed by any author, I showed some of the specimens to Mr. Salter, then of the Geological Survey, who suggested that they probably might be analogues of the aquiferous channels found in recent Echinoderms; and he advised me to follow up the subject, and ascertain if such passages were to be found in other *Crinoidea* occurring in these rocks. His advice has been followed, and a large collection of specimens, some in good preservation and others weathered, has been made, which I have had the advantage of collating with a series from the same district collected by Mr. James Parker of the Manchester Museum; and upon examination they give the following results, some of which, though probably of no great importance in themselves, may serve to illustrate some doubtful points in the organization of this confessedly obscure Order of the Animal Kingdom.

It is unnecessary here to give in detail the construction of the arms of the *Crinoidea*, as that has been done so satisfactorily by Messrs. Austin, M. de Koninck, and others; but, as I shall have hereafter to point out an exception, it may be shortly stated that they describe these arms as not being truly cylindrical, but as formed like a cylinder, or branching cylinders, having a deep longitudinal groove along the upper side, with a row of tentacles on each of its margins, forming an open channel throughout the whole length, until the arms join the body; but at this point, it will be seen from what follows, this channel is divided into two passages, an upper and a lower; the former passing up within the dome to the apex, where the passages from the five arms meet, the latter going direct into the visceral cavity.

The species in which these passages were first observed by me is *Amphoracrinus** *rugosus*. In this, and in all the species of this genus hitherto examined, the plates forming the dome are extremely thick; and the upper passages above named are, for at least two-thirds of their length, in the substance of these plates; but in *Actinocrinus* the plates are thinner, and are arched over the passages. In the angle between two of these passages, on the anal side, the proboscis is placed. In *Actinocrinus* this is close to the junction; but in *Amphoracrinus* it is more or less removed from the angle. Plate VIII. fig. 1, is a horizontal section of a specimen of

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* To avoid repetition and confusion, the genus *Actinocrinus* is, in this paper, divided into its sub-genera *Actinocrinus* and *Amphoracrinus*.

Amphoracrinus, showing the passages within the thickness of the plates; and fig. 2 is an elevation or side-view of another specimen, exhibiting both the openings into the visceral cavity at *a*, and the passages towards the apex at *b*. Fig. 3 is a view of the cast of a dome of *Actinocrinus tessellatus*, showing the five passages meeting at the apex, with the base of the proboscis in the anal angle. The position of the proboscis may be verified by tracing from the anal plate at the base.

2. *Cyathocrinus.*

Casts of some species of *Platycrinus* have been found showing passages similar to those in *Actinocrinus*; but in the genus *Cyathocrinus* the passages into the viscera and to the apex are better seen than in any other; and from this genus a clue to their nature may probably be gained. The arm-bearing plates, or 'primary radials,' of *Cyathocrinus* are deeply notched, or cut down, at the insertion of the arms; and the upper part of the plate on each side of the arm is in-arched more or less in different species, so as partially to cover the dome.* The 'radial plates' are attached to each other at their sides; and at the junction of their upper ends each pair form a very obtuse angle, into which a tetragonal plate is fitted; but the sides of these last plates are produced across the notch in the 'radial,' so as to meet each other, the projecting part being grooved out so as to form a channel from the base of the arm to the centre of the dome, where the five channels meet in a round aperture, which is described by M. de Koninck as the mouth; the proboscis at the side being considered the anus. This arrangement of the plates in *C. planus* is shown by fig. 4. I have not found any radial plates formed as described by Messrs. Austin; but in such a case the above tetragonal plates would form a continuation of the groove to the mouth. Specimens of *Cyathocrinus* showing the passages from the arms meeting at the central opening are not uncommon; but in the British Museum, and in Professor Tennant's collection, there are specimens which show that these were covered with thin plates like those in *Amphoracrinus*, thus being within the thickness of the dome, as in that genus; and that the mouth, if such was the circular aperture, was internal, as in the Ascidians. With the exception of the mouth, the only apparent difference in the organization of the above Crinoids is that in some the passages are in, and in some under, the plates of the dome; and with respect to the mouth, although we have as yet no specimen showing its existence in some of the genera, it would be too much absolutely to deny it, when in so many other respects they appear to be similarly constituted.

It is probably presumption at present to speculate on the nature or uses of these passages; but they appear to give strength to the idea suggested by Mr. Sowerby (Zoological Journal, vol. ii. p. 313), when speaking of the *Blastoidea*, 'that the animal fed on the minute beings that abounded in the sea-water, and that it obtained them in the manner of *Ascidia*, by taking them in with the water;' and to the statement of M. Dujardin, when describing *Comatula*, 'that the ventral surface of the arms and pinnæ is provided with a double range of fleshy tentacula, protected by a double range of fleshy lamellæ, presenting between them a furrow filled with papillæ, furnished with vibratile cilia, by the motion of which animalcula and microscopic vegetables are conducted along the arms to the mouth, in order to serve as food for the animal.' It certainly does appear more probable that an animal, fixed to one spot, and probably in deep water (for, if within the reach of storm-waves, its long branching arms would be caught by them with force sufficient to break the body from the slender column of attachment), would have to depend upon minute organisms abounding in sea-water, rather than upon such Crustaceans or Mollucs as might perchance come near it. If we assume M. Dujardin's statement to be correct, the upper passages, above described, would be for the supply of food, and of water for respiration; whilst the lower served probably for the passage of the muscles which gave motion to the arms and their appendages, as well as for the connection between the visceral cavity and the ovaries, if they were situated in the arms of the *Crinoidea* as in *Comatula*.

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* Messrs. Austin, when describing *Cyathocrinus*, say—'The ray-bearing plates are perforated low down from their upper edges, for the passage of the muscles of the rays. A deep groove runs from each perforation to the summit of each plate, which is prolonged considerably beyond the point of attachment for the rays, and is in-arched, so as to partially cover in the vertex. This is particularly conspicuous in *C. geometricus*, and appears to be very common in Crinoids of this genus.'

3. *Rhodocrinus.*

The genus *Rhodocrinus* (Miller), or *Gilbertsocrinus* (Phillips), is not uncommon in this district. Miller appears to have confounded a Silurian specimen with the Mountain-limestone genus, and figures one from Dudley, which, so far as can be determined from the imperfect specimen, was of a different genus. Those, however, which he describes from near Bristol are undoubtedly *Rhodocrini* of the Mountain-limestone. This genus differs from most other *Crinoidea* in the form of the arms and the position of the ovarian apertures; and in these respects it appears to hold the same relative position to them as the *Ophiuridæ* do to the *Asteriadæ*. The arms have no groove on the upper side, but are cylindrical, with a tubular canal through the axis; and the ovarian openings are placed immediately under the base of the arms (figs. 5 and 6).

The arms vary in size in different species; in some being almost equal in diameter to the column or stem; whilst in others they are very small. The rarity of specimens with any portion of the arms attached, and the peculiar shape and position of the ovarian openings, have led to these latter being mistaken for the excavation for a cuneiform plate at the base of the arms, as they are at first sight very similar to those in *Platycrinus* and in some species of *Cyathocrinus*;* but in a well-preserved specimen from Thorneley there appears to be a fillet round the aperture, very like that round the ovarian openings in *Gorgonocephalus*, excepting that in *Rhodocrinus* the fillet is formed by a small plate, as shown in fig. 6, and not by a thickening of the integument.

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* Phillips, in his 'Geology of Yorkshire' (Part II., Pl. IV. fig. 25), gives a diagram of one set of radial plates in which the ovarian openings, under the base of the arms, are clearly indicated.

Mr. Billings, in the 'Third Decade of the Geological Survey of Canada,' in treating of the ambulacral openings of *Rhodocrinus*, says—'In no other species is there more unequivocal evidence of the existence of these openings; but they are accompanied by a structure which seems to indicate two sets of arms placed one above the other. Beneath the orifices there are two articular surfaces, which mark the bases of two arms; and above each pair of the orifices there is a projection, which also much resembles the base of one or two more arms. . . . In some of the specimens this feature is exhibited so prominently that it strongly impresses the observer with the idea of two tiers of brachial appendages. It may be, however, that there were projecting from this part of the vault a set of large spines corresponding in numbers with the arms.' Since, however, Mr. Billings's paper was published, more perfect specimens have been found with portions of the arms attached; and their articulated structure, and the passage through the axis, forbid the idea of their being spines; and an examination of the specimens in the Museum will leave little doubt of the true nature of either the arms or the lower openings. No specimen has yet been found showing distinctly the course of the upper passages, as in the other *Crinoidea*; but they evidently turn upwards under the dome. The anal opening is excentric; and, supposing the passages to exist, as there is reason to suppose they did, as in other genera, this opening would be between them.

4. *Pentremites.*

Having so far examined the *Crinoidea*, it became a matter of interest to see how far the *Blastoidea* corresponded with them. As in the former case, a number of weathered specimens were procured, and sections of more perfect ones were made; and from their examination it appears that the external characteristics of *Pentremites* are correctly described by M. de Koninck. The base, like that of *Platycrinus*,* is composed of three pieces; two, of equal size, being pentagonal, and the other quadrilateral and smaller. Upon this base rest five 'radial plates,' similar in form and size. They are attached to the base-plates as in *Platycrinus*; that is, two of these plates join to the upper sides of two of the pentagonal pieces; whilst the other three alternate or break joint, and are in contact with two adjacent plates of the base. The radial plates are very similar to those of *Platycrinus*; but, instead of the semilunar depression for the attachment of the arms in that genus, there is in *Pentremites* a deep excavation, or sinus, down the middle of each plate, giving it somewhat the appearance of a fork with two broad prongs. The upper sides of the adjoining radial plates are connected by a quadrilateral plate, fitted into the more or less obtuse angle formed at their junction (in this strongly resembling the plates on the dome of *Cyathocrinus* above noticed); whilst the two other sides of this plate form continuations of the sinus nearly to the summit. So far, undoubtedly, *Pentremites* may be considered to be allied to the *Crinoidea*; but beyond this they appear to differ; for, instead of the long branching arms attached to the radial plates of *Crinoidea*, there is only a row of short fimbriated tentacles, ranging along each side of the above sinus, nearly meeting in its centre, and forming the so-called 'pseudambulacral area.' The removal of the tentacles (which, however, are not often found *in situ*) leaves a groove down each side of the sinus; and at the bottom of this a row of minute pores is seen. On making a cross section of a Pentremite, it is found that these pores are openings into one or more flat tubes, varying in number in different species, which pass from the base of the sinus to the apex, and are attached nearly at right angles to the plates on each side of the sinus by one edge; whilst the inner edge, which projects into the visceral cavity of the animal, expands so as to form a nearly circular tube as seen at fig. 7, which is a section of *Pentremites ellipticus*. Varieties of this species and of *P. orbicularis* are the most commonly found in this district; and they all have only one tube to each side of the sinus, and appear to have in all respects similar organization. As these flat tubes approach the summit, they become gradually narrower; and at the apex of the quadrilateral plate the expanded parts of the tubes from the adjoining sinus (and not from the same sinus) meet, and form one of the summit-openings characteristic of this genus. These flat tubes may be called the 'pore-tubes;' and the interval between those in each sinus is filled by what M. F. Roemer calls the 'lancet-plate,' which forms a bed for the tentacles, and is slightly indented to receive them; but in many species of Pentremite, if not in all, this lancet-plate is in reality a compound plate, formed of two contiguous plates, extending from the bottom of the sinus to the top, and, there turning right and left round the summit-openings, they pass down the adjoining sinus, to form half its lancet-plate, leaving at the apex of the body a pentagonal aperture, supposed to be the mouth. In some weathered specimens, the two parts of the lancet-plate are separate; and in many they appear to meet only at the top and bottom of the cross section, leaving a lozenge-shaped opening between them, as shown at *a*, fig. 7.

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* In well-preserved specimens of plates of the *Crinoidea*, and probably of all the *Echinodermata*, the face of the joints of the plates is minutely wrinkled or corrugated, which will at once distinguish true joints from fractures. By this means the doubt as to the construction of the base of the *Platycrinus* has been removed, a divided base having been found showing the wrinkled structure on the face of the joints. As these bases are generally found whole, and very rarely in detached plates, most probably M. de Koninck's view, that in full-grown specimens they are anchylosed into one, is correct.

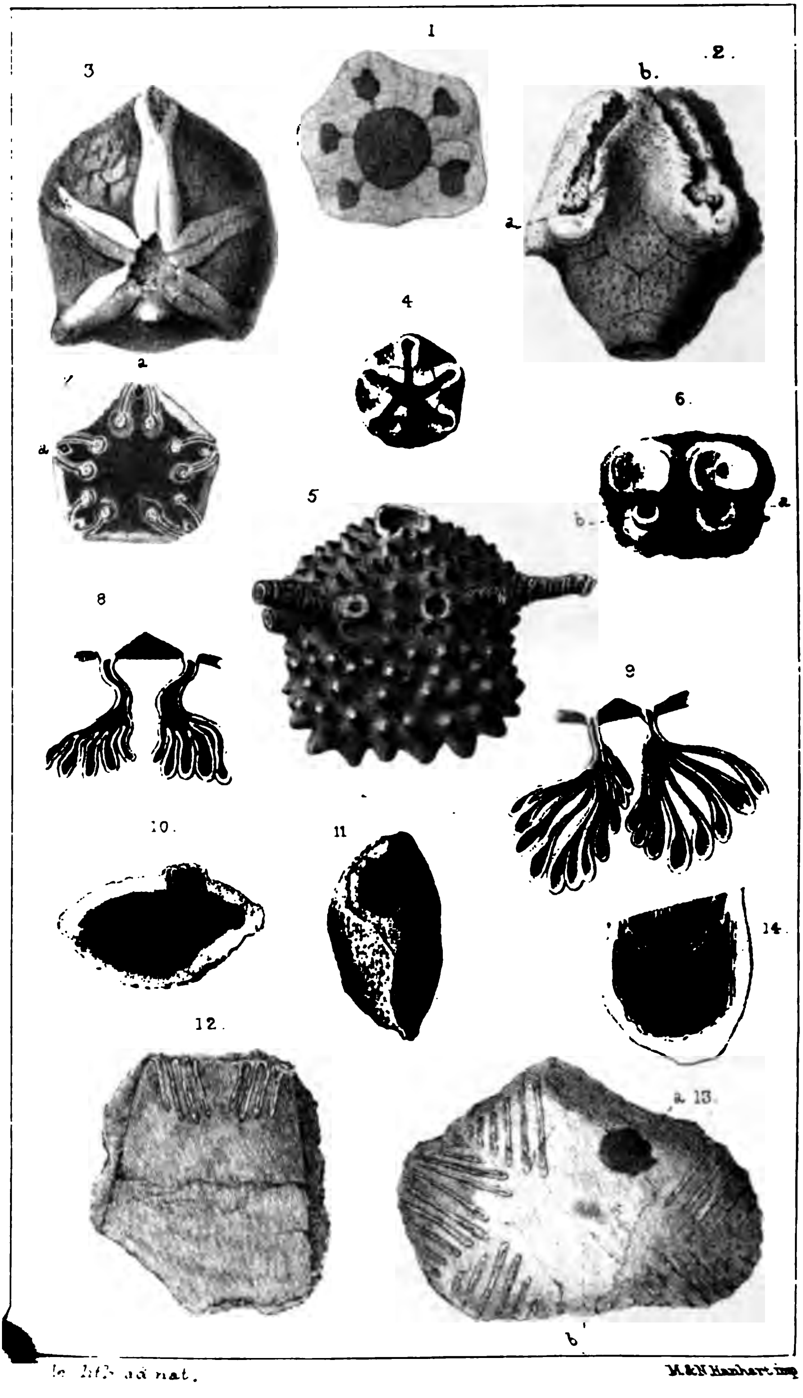
Possibly we should not be very far wrong if we were to suggest that the tentacles of *Pentremites* represent the arms and tentacles of *Crinoidea*, and the internal tubes of the former those under the dome of the latter; and in that case *Pentremites* would be nearly allied to *Crinoidea*.

Specimens of some American *Pentremites* (*P. florealis*), which have been cut for the sake of comparison, show a very similar structure to *P. ellipticus*, with the exception that there are from four to six tubes connected with each row of tentacles, instead of one, as in that species; and those tubes are formed of a thin test folded longitudinally, so as to form a number of flat lobes or tubes, which communicate with one another at the outer edge, whilst at the inner edge they expand into tubes, as seen in fig. 8, which is a section of a pair of these tubes, with the intervening lancet-plate, showing the connection with the pores, and removing the difficulty stated by M. Ferd. Roemer in his 'Monograph on the Blastoidea,' as it will be seen that the compressed longitudinal tubes shown in his Plate IV. fig. 6, are really the lobes of the above-described tube. An examination of the specimens (both vertical and horizontal sections) now in the British Museum will leave no doubt on this point.

Pentremites inflatus (Phillips) and *P. Waterhousei* (de Koninck) differ from all the above, as they do not show the summit-openings, from which this genus derives its name; but they have one large circular opening at the summit of one of the quadrilateral plates, in the place usually occupied by the largest of those openings, and which is shown by Prof. Forbes to be anal. In the comparatively few good specimens I have been able to procure, no trace has been found of the pores at the base of the tentacles; but the tentacles appear to be inserted in a groove which forms the outer edge of the lobed tubes (similar to those in *P. florealis* above described), and which in these species appear to pass to the summit under the shell, and to open within the body, as above seen in *Cyathocrinus*. Neither the grooves nor the tentacles in these species extend quite to the top of the sinus. Fig. 9 is a section of a pair of the tubes of *P. inflatus*, from Bolland, which resembles *P. florealis*, but has more lobes to the tubes.

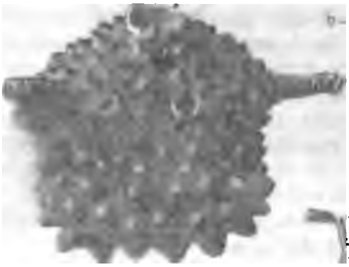
5. *Codonaster.*

The similarity in the arrangement of the plates forming the 'cup' of this beautiful little fossil to that of some of the *Crinoidea*, and the resemblance of the rows of tentacles to those of *Pentremites*, suggested a similar organization, and led to the anticipation of finding similar pores and tubes attached to them; but on cutting many specimens no trace of such appendages has been found. Sections thus made show, however, a great similarity in the construction of the striations between the arms of *Codonaster* and those of the 'pectinated rhombs' of the *Cystidea*. Professor M'Coy, in the 'Cambridge Pal. Fossils,' notices their external resemblance. Professor E. Forbes, in his 'Memoir on the Cystidea,' when describing the 'pectinated rhombs,' refers to a figure of a specimen of *Echinoencrinus prunum*, from Mr. Capewell's collection, in which the striæ penetrated into the substance of the body; but he was inclined to regard the appearance as dependent rather on some peculiarity in the mineralization of the specimen than on true organic arrangement. Mr. Billings, in his paper on the structure of the *Cystidea*,



[illegible] lith ad nat.
M&N Hanhart imp

STRUCTURE OF ECHINODERMATA.



in the 'Third Decade of the Canadian Geological Survey,' describes their 'rhombs' as 'pores which penetrated through the plates of the body, and probably served as media of communication between the interior and exterior of the body, although the precise nature of their functions has not yet been ascertained.' Figs. 10 and 11 are vertical and horizontal sections of the 'pectinated rhombs' of *Echinoencrinus armatus*; and figs. 12 and 13 are like sections of the summit of *Codonaster*: and it will be seen that in each case the ridges on the striated surface are the tops of a series of folds of a thin test or membrane; the alternate folds being so united at their ends as to form a series of long, but very narrow, sacs. In some specimens of *Codonaster* there is an appearance of a membrane, or peritoneum, lining the cup, and following round the outline of, and forming bags under, the above folds, as shown in fig. 14.

From the construction of these striations on the face of *Codonaster* and on the 'pectinated rhombs' of the *Cystidea*, may we, without assumption, suggest the possibility of their being respiratory sacs, lined with cilia,* and constructed of a porous test, through which air from the water could pass by diffusion?

Beyond the form and construction of part of the cup, there appears to be little in common between *Codonaster* and *Pentremites*; and it must then be doubtful whether they should be left in the same family (*Blastoidea*), as the latter is apparently more nearly allied to the *Crinoidea*, whilst the construction of the 'rhombs' shows an affinity between the former and the *Cystidea*. *Codonaster* may possibly hereafter be found to be the representative of *Cystidea* in the Carboniferous series, or perhaps a connecting link between *Crinoidea* and *Cystidea*, having the cup of the one with the respiratory apparatus of the other.

EXPLANATION OF PLATE VIII.

Fig. 1. Horizontal section of *Amphoracrinus*, cut below the proboscis, which would be on the lower side of the figure.
2. Side-view of *Amphoracrinus*: *a*, the opening, at the base of the arms, into the visceral cavity; *b*, the passages in the shell from the base of the arms to the apex.
3. Cast of *Actinocrinus tessellatus*, Phillips.
4. Top-view of *Cyathocrinus planus*, Miller. The proboscis, on the lower side of the figure, is broken off.
5. Side-view of *Rhodocrinus*, with portions of the arms attached.
6. A pair of the arms of *Rhodocrinus*; enlarged about $\frac{4}{1}$; showing the openings under them: *a*, opening with striæ round it for the articulation of the fillet *b*, shown under the other arm.
7. Section of *Pentremites ellipticus*, Sowerby; enlarged: *a*, the opening in the 'lancet-plate.'
8. Section of a pair of tubes and the 'lancet-plate' of *Pentremites florealis*, Say; much enlarged.
9. Section of a pair of tubes and the 'lancet-plate' of *Pentremites inflatus*, Sowerby; much enlarged.

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* Cyclopædia of Anatomy and Physiology, vol. ii. p, 40, and vol. iv. p. 332.

10 & 11. Vertical and horizontal sections of the 'pectinated rhombs' of *Echinoencrinus armatus*, Forbes; enlarged $\frac{3}{1}$.

12 & 13. Vertical and horizontal sections of *Codonaster*; enlarged $\frac{4}{1}$: *a*, the position of the anal; *b*, of the central opening.

14. Vertical section of *Codonaster*; enlarged about $\frac{3}{1}$; showing the lining membrane.

III. Geological Notes on Scotland.—No. I.

By George E. Roberts, Esq., F.G.S., &c.

ANY Geologist travelling to Nairn, *viâ* Perth, will be interested (in a degree compatible with his sense of the nuisance created) in the wonderful outspread of wind-blown sand between Dalwhinnie and Kingussie. I do not know any more wonderful *drift* of sand than is here displayed; a sand-surface so constantly in motion, that I believe it must really be in connection with the ever-shifting sand-drift of Culbin, near Elgin, which may be rightly termed the British Sahara. The nuisance caused by the constant settlement, even in the calmest weather, of this fine-grained siliceous sand upon everybody and everything passing through the district, was annoying enough, even in the old coaching days, but is increased tenfold to the traveller now that the Central Scottish Railway has superseded the more tedious method of travel; for the more rapid rate of motion raises such legions of blinding sand-atoms, that when Forres Junction was reached, a traveller is scarcely recognizable for the dust, and the vacant cushions are coated two inches deep. Indeed, I would call special attention to the Sands of Culbin, mentioned as probably being in geographical connection with the shifting sands cut through by the railway, as they have afforded the best instance of a real sand-storm known in Britain; hills of blown sand, from 60 to 100 feet in height, and from 200 to 300 feet in circumference, having been formed by wind-action during a single night.

The remarkable isolated mound of gravel and sand which stands in the throat of the Great Glen, about half a mile from Inverness, has always claimed the interest of geologists specially interested in the subject of drift-accumulations. To those who have not seen it, I may explain that it is a mound, about 130 feet high, 600 long, and 250 wide, shaped like a galley turned upside down, from whence its name, Tomnahuirich. It is undoubtedly the remains of an accumulation of water-borne drift derived from the hills which tower over the chain of lakes now utilized as the 'Caledonian Canal.' I allude to it, however, on account of its geological composition having now been placed beyond a doubt; for however much I regretted to find that the well-wooded sides of the mound had been despoiled of some of their trees by the axe, I was rejoiced to see what fine sections were laid bare of well-stratified layers of sand and gravel, showing that the mound was but the remaining portion of a huge sand-bank which must, at a time prior to its denudation, have nearly closed the entrance of the 'Straits of Ness.' The spoliation of Tomnahuirich was a consequence of the hill having been chosen by the Town-Council of Inverness as the site for their new cemetery; and a more beautiful spot for the repose of the dead could not be chosen. A fay-tale is out of its place in a scientific paper, however 'chatty' the character of that paper may be ; but as most geologists care for fay-folk that can walk and talk and love and be good, I may, perhaps, be allowed to say, before passing on to my next note, that some time before Tomnahuirich was made a cemetery, an author of fairy-tales, hearing that the hill was a spot sacred to the Fays as their great Meeting-place, wrote a story of an imaginary Meeting-day, at which a child, the noblest gift the fays could offer at the throne of their King, was sought for and offered, as a proof that goodness had not departed from the world. My note-book gives me a corollary to this fayland-fancy, in one sense a sad one—two children were the first burials in Tomnahuirich.

I now come to a study which has, more than any other in Scotland, challenged the best wits which have been brought to bear upon it; that of the so-called Elgin beds. 'Upper Old Red,' say one school of geologists; 'Trias,' or 'Lias,' say the other disputants. I plead myself entire incapacity to decide *as the matter now stands*; for the palæontological contents of the series of beds (apparently conformable) which are exhibited in the Lossiemouth, Tarbotness, and other sections, received last year a considerable and very important addition through the labours of Mr. Smith, a most intelligent officer on the staff of the Highland Railway, who carefully watched the progress of the cuttings through the disputed land, and collected from the 'Yellow Beds' some very remarkable cephalic plates of Fishes, probably belonging to a genus having alliances with *Coccosteus* and *Asterolepis*. Now, these fossils were met with in the rock which has long been known as bearing remains, more or less perfect (the finest yet discovered being those exhibited last year in illustration of my paper on the genus), of the largest yet-known Palæozoic Fish, *Bothriolepis*. These are certainly in the *Holoptychius*-zone of the Upper Old Red, typified by the rocks quarried so extensively at the Bishops' Mill quarry, near Elgin, at Alves, and at other places to which I accompanied Prof. Harkness in 1863 ; and the desideratum has always been to obtain *Holoptychius* associated with a reptile-bone. I have very carefully examined the large collection made by Mr. Smith, with the hope that the question may be settled ; but although I could find no good evidence of the association of the two orders of vertebrate life in the same rock, some very puzzling fragments of bones strengthened my hopes that, at some early day, the Yellow Sandstones generally of NE. Scotland, with their reptilian remains, *Stagonolepis*, *Telerpeton*, &c., will be regarded as the representatives (though probably during a somewhat more advanced period) of the well-known 'Yellow Sandstones' which cap our English and Irish 'Old Reds.' The specimens obtained through the watchfulness of Mr. Smith are now in the National Collection. As yet they are unique.

I scarcely understand why either palæontologists or stratigraphical geologists should not concede these 'Elgin beds' to the Old

Red Sandstone series. Such concession would not mean that their date of deposition, with reference to the burial of the ***Stagonolepis*** in the siliceous and aluminous muds of the estuary, was exactly coeval with the time when some few representatives of the ***Pterichthys*** family found their way down south, and lived in the shallow waters which washed the shores of certain islands, now known to us, geographically, as parts of England and Wales; to wit, Shropshire, Herefordshire, and Monmouthshire; for it is very doubtful whether any scheme exhibiting the contemporaneity of one deposit with another in time can be drawn. Indeed, it must be borne in mind that any one period in geological time studied for any scientific purpose must necessarily be regarded as a geographical study, and that the landscape which the mind of the student draws out of the materials at his disposal is one very liable to error; for, when stretched before his mental vision, it has to be tested by geographical conditions now existing on the surface, and not by any presumed state of affairs common to the whole physical and palæontological economy of the world. Dame Nature shifts the scenes in a very complex and elaborate manner, and 'rings in the next piece' with a complete knowledge of the varied and numberless interests involved in its construction.

IV. ON THE GEOLOGY AND PHYSICAL FEATURES OF THE VALLEY OF THE JORDAN, THE DEAD SEA, AND THE ADJACENT DISTRICTS.

By the Rev. H. B. TRISTRAM, M.A., F.L.S.

[Abstract of Paper read before the British Association, September 1865.]

MANY travellers have spoken of the numerous traces of volcanic action to be found in the neighbourhood of the Dead Sea; but the author states that he invariably found the 'lava-currents' of M. de Saulcy to be nothing more than deposits of silica and nodules of oxide of iron, while his 'extinct craters' proved to be the flat summits of limestone-hills.

The two parallel ranges of hills which run nearly north and south, and form the eastern and western margins of the valley which includes the Ghor and the Dead Sea, and extends nearly to Akabah, consists chiefly of rocks apparently of the age of the Lower Chalk, and having a synclinal dip. Round the shores of the Dead Sea, there are abundant traces of a much more recent deposit, probably Post-tertiary; it is a saliferous marl, containing unfossilized Shells of the species that now exist in the Jordan.

Descending from Jericho to the Dead Sea (a fall of 600 feet), a good notion of the physical features of the country may be obtained. First, there is an old terrace-line, about 400 feet above the present level of the Jordan, formed of a very coarse and soft limestone; then the lower terrace-line, 55 feet above the present level of the plain, composed of friable earths strongly impregnated with various salts, and having a slight but hard saline crust at the top, besides many interstratified layers. This second terrace is scarped and furrowed in all directions by aqueous action, and where the plateau projects into the plain it forms the tops of a series of mamelons, which could not be well illustrated except by photographs. This plain itself is a soapy marl, and at a slight depth below the surface presents the appearance of a rich loam; but the only plants existing were two species of *Salsola*.

This deposit of marl, extending all round the shores of the Dead Sea, and up the Wadys which open into it, forms the chief feature in the geology of the district. Above it, three water-worn terraces, corresponding on both sides of the Ghor, can be distinctly traced in the Cretaceous cliffs.

South of the Wady Dabur, at the north-west end of the Dead Sea, a mass of igneous rocks crops out of the hills like a dyke, in three ridges, cutting through the gravel at an angle of 70 or 80 degrees. The cliffs above the slopes generally consist of a sandy limestone, very variable in its texture, and frequently mixed with conglomerate, containing pebbles of all sizes. Near Feschkah a basaltic dyke runs NE. and SW. Four hot sulphurous springs occur between Ras Feschkah and the south-west end of the Dead Sea, at a short distance from the shore; the temperature of the water in some of them rises to 120° Fahr., and sensibly affects that of the sea at a distance of many yards.

Mr. Tristram then described the hill of Jebel Usdum, which is a huge ridge of salt, about a mile wide, and running NE. and SW. for a distance of three miles and a half, then due N. and S. for four miles further; it is situated near the southern extremity of the Dead Sea, and renders that end of it much more salt than the northern portion. Further, the author thinks that it is the proximate cause of the saltness of the Dead Sea, the drainage to which has been dissolving away portions of the salt, and carrying it to the Dead Sea, ever since the elevation of the ridge of Akabah separated the latter from the Red Sea, or since the dessiccation of the ocean, which existed to the Eocene Period, presuming (which seems most probable) that the fissures of the Ghor were of submarine origin, and that the valley itself was during the Tertiary Period the northernmost of a series of African lakes, of which the Red Sea was the next. The volume of the Dead Sea from that time continually decreased, by the evaporation of its water, probably to the time of the Glacial Epoch, of which we find traces in the Lebanon and elsewhere, so that two causes have combined to increase the intensity of its saltness, which is still becoming greater, though the volume of water has probably been in equilibrium since the termination of the Volcanic and Glacial Epoch. Sulphur and gypsum are associated with salt at the foot of Jebel Usdum: and there is an extensive deposit of sulphur and bitumen in the Mahawat Wady, two miles SW. of the Dead Sea.

The author then gave a general sketch of the geology of Palestine. The Lower Cretaceous period is the only one represented by sedimentary rocks; but in the north-east, in the Lejah district, volcanic rocks occur abundantly; and Mr. Tristram concluded his paper by describing the extinct volcanos, and the ancient lava-streams of the valley of the Hieromax, the shores of the Sea of Galilee, and other portions of the North of Palestine.

V. ON SOME DEPOSITS OF LATE TERTIARY AGE AT MATURA, ON THE EAST COAST OF TRINIDAD.

By R. J. LECHMERE GUPPY, Esq., Civil Service, Trinidad.

§ 1. *INTRODUCTION.*—In the Map appended to the 'Report on the Geology of Trinidad,'* we find the principal Tertiary coal-bearing strata of the Island indicated by a more or less irregular band of dark colour, stretching from Chaguanas, Couva, and Savonetta, on the western or Parian coast, to Manzanilla on the eastern or Atlantic side. To the north of this band lies a sterile region of detrital matter, chiefly siliceous, marked in the map by yellow with red spots. I wish to draw attention more particularly to that part of this latter formation which lies on the eastern coast between the River Matura and Saline Bay.

On approaching Matura from Valencia, after having crossed the Oropouche River, an evident change for the better is observable in the nature of the soil; for, instead of the intensely sterile quartzose sand and white clays which form the principal part of the 'stratified detritus,' we find that a portion of calcareous matter has mingled with the earth, and rendered it a little more suitable for agriculture. This calcareous matter seems to have been derived from underlying beds, which might probably be classified as belonging to the 'upper part of the Newer Parian' of the Government Geologists. These beds are in part composed of a dark-coloured and fine-grained calcareous sandstone, containing an abundance of small shells. No great extent of these beds is exposed; but near the Rincon, a natural savanna bordering on Matura Bay, the erosion caused by a small stream, and the wasting action of the sea, have brought into view a fossiliferous bed, the organic remains from which may probably give us an insight into the question of its age, and may even lead to a knowledge of some of the physical phenomena which succeeded the deposition of the earlier Tertiaries of the Island.

§ 2. *Organic Remains.*—The fossils found by me in the beds alluded to amount to more than ninety species, and have relationships with the recent fauna, with the fauna of the 'Post-pliocene' deposits of the Antilles (Barbados, &c.), and with that of other Tertiaries in this Island. As respects the two former cases, I have been able, for the most part, to compare specimens; but in regard to the Newer Parian fossils, I have not been able to obtain such full information as is desirable. The indications furnished in the Appendix to the Geological Report† are very meagre; and, after a lengthened, but nevertheless somewhat unsatisfactory, examination of the Matura fossils, I have drawn up the following list.

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* Memoirs of the Geological Survey: Report on the Geology of Trinidad; or Part I. of the West Indian Survey; by G. P. Wall. from the Government School of Mines, Jermyn Street, and J. G. Sawkins, F.G.S. 8vo. 1860. London: Longman and Co.

† Report on the Geology of Trinidad pp. 161–166.

List of Fossils from the Rincon, Matura, Trinidad.

(VN., very numerous; N., numerous; R., rare.)

† Fusus, R.
* Murex, R.
Pyrula canaliculata, *Lam.*
† P., sp.
Nassa incrassata (?), *Müll.*
Buccinum clausiliforme (?), *Kien.*
* Terebra succincta, *Gmel.*, R.
* Columbella, sp.
† C., sp., R.
Fossarus costatus (?), *Brocchi*, R.
* Oliva oryza, *Lam.*, VN.
* Conus venulosus, *Brug.*
Pleurotoma sinuosa, *Mont.*
* P. fusca (?), *Gray.*
P. virgo (?), *Lam.*
P. nodifera (?), *Lam.*
† P., sp.
Daphnella sicula, *Reeve.*
* Volvaria catenata (?), *Mont.*, sp., N.
* Persicula, sp.
* Marginella cærulescens, *Lam.*
† M., sp.
* Erato, sp.
* Natica straminea, *Recluz.*
† Odostomia, sp., R.
† Chemnitzia, sp.
* Eulima polita, *Lin.*
* Cerithiopsis, sp.
* C. subulata, *Mont.*
Triforis ventricosus, *Gmel.*
Leiostraca acuta, *Sow.*
* Scalaria pyramidalis, *Sow.*
* Turritella imbricata, *Lin.*
† T., sp.
* Cæcum pulchellum.
Vermetus royanus, *d'Orb.*
* V. lumbricalis, *Lin.*, N.
* Siphonium decussatum, *Gmel.*
Trochus granulatus (?), *Born.*
† T., sp., R.
* Sigaretus Delessertii, *Chenu*, R.
† Adeorbis, sp., R.
† A., sp., R.
† A. (?), sp., R.
* Fissurella pileola, *Dil.*
* Crepidula aculeata, *Lam.*
Calyptræa (? Crucibulum) albida (?),
Crucibulum striatum, *Say*, N.
C. tubiferum, *Sow.*, N.
* Dentalium apicinum, *Lam.*, N.
* D. entale, *Lin.*
Chiton, sp., R.
* Tornatina olivula, N.
* Bulla striata, *Brug.*
* Physa ancillaria, *Say*, R.
* Planorbis, sp., R.
Ostrea cucullata, *Born.*
O. cucullata (?), *var.* terebratuliformis, R.
Pecten nucleus (?), *Born.*
* Modiola sulcata, *Lam.*
* Arca Noæ, *Lin.*, N.
* A. solida, *Sow.*, N.
* A. donaciformis, *Reeve.*
* A., sp.
† A., sp.
* Pectunculus decussatus, *Chemn.*
Nucula similis (?), *Sow.*
† N., sp., R.
* Leda eburnea (?), *Sow.*
* Chama macrophylla, *Chemn.*
* Cardium isocardium, *Lin.*
† C. (Papyridea), sp., V.N.
C. obovale, *Sow.*, N.
* Lucina squamosa, *Lam.*
† Diplodonta (?), sp.
* Strigilla carnaria, *Lin.* sp., N.
* Astarte (Gouldia) Martinicensis, *d'Orb.*, V.N.
* Venus pectorina, *Lam.*, N.
* Venus cingenda, *Dil.*
* V. macrodon, *Desh.*
† Cytherea, sp., R.
* Trigona mactroides, *Chemn.*
† Tapes, sp., R.
* Mactra turgida, *Gmel.*
† M. (?), sp., R.
Donax fabagella, *Lam.*
* D. striata, *Lin.*
* Tellina acuta, *Wood*, R.
* Corbula pygmæa, *Hanley*, V.N.
* C. bicarinata, *Sow.*, V.N.
C. pisum (?), *Sow.*
* Gastrochæna ovata, *Sow.*
* Pholadidea calva, *Gray.*

† Lunulites, sp., V.N.
Cellaria salicornia, *Pallas*, R.
† ? Discopora, sp.
? Eschara, sp.

In addition to the fossil *Mollusca* and *Bryozoa* enumerated in the foregoing list, there are a few small bones, probably of Fishes, and a single tooth has come to light. There are also remains of Cirripedes (*Balani*), and fragments of *Crustacea* (brachyurous decapods); also a few spines and fragments of Echinoderms.

The Shells marked* in the preceding list are known to me, by recent examples, to be still existing in neighbouring seas. Those marked† are species otherwise unknown to me, either by books or specimens. *Ostrea cucullata* is, I believe, a shell of the eastern seas. *Cardium* (*Papyridea*), sp., is allied to the recent *C.* (*Papyridea*) *ringiculum*, but is much smaller and thicker.

It will be observed that there are 27 species known as existing in contiguous waters, out of a total number of 56 Gasteropods, including two freshwater shells and two opisthobranchs. Then 16 of the remainder, if not found in the surrounding seas, are probably existing elsewhere. To two of these I have assigned the names *Nassa incrassata* and *Trochus granulatus*, on account of their resemblance to the European species of those names, but at the same time with much hesitation.

The proportion of recent species thus arrived at is nearly 80 *per cent.*; or 20 *per cent.* of unknown and extinct species. Making due allowance, however, for imperfect knowledge, there would probably remain at least 10 *per cent.* of extinct species of *Gasteropoda.*

With regard to the *Conchifera*, the proportions are nearly the same. There are 22 species, out of the total of 36, which are certainly known to me to exist in contiguous seas. To this number may be added four species, some of which probably exist elsewhere. *Nucula similis* and *Corbula pisum* are species of the European Eocene. I can detect no difference between the examples from Matura and the English species; but some doubt, of course, rests on the determination, owing to the distance both of locality and of time. I think, from what has been stated, that we may consider it moderately safe to infer, that of the fossil Mollusca of the Matura deposit there is a percentage of at least 10 extinct species. This would bring the deposit within the Pliocene Period according to the classification of Lyell;* and, in searching for European equivalents, we should probably find that the Glacial deposits of Europe present the closest analogies with the Matura beds.

I may remark, by the way, that the fact has not practically been overlooked by Geologists, that even where all the species are recent, yet, if some of them are only found in distant seas, and exist under different climatal conditions to what those occurring in the localities where such species are found fossil lived under, the differences between the recent and fossil faunæ mark a real progress in geological time, and entitle the strata from which the fossils are obtained to a distinctive name. The Matura deposits are, however, less remarkable in this respect than in regard to the small size of the Shells found in them; a point which will be dwelt upon in the following sections of this paper.

§ 3. *Conditions of Deposit.*—It is probable, from the sandy nature of the beds, that they were not thrown down at any very great distance from land; while it could hardly have been as a beach that the deposit was accumulated. The Shells are many of them too fragile to have withstood the attrition which accompanies exposure on a beach. We must look, therefore, for a condition intermediate between the two as probably the nearest to the truth; and we find that the fauna is one which would, in most respects, suit a depth of from 20 to 50 fathoms.

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* Lyell, Manual of Elementary Geology, 5th ed., p. 105, and Supplement, p. 13.

On those tropical beaches where Univalves predominate, we have *Litorina*, *Patella*, and *Nerita*. None of these are represented in the Matura beds. On the other hand, on those long stretches of sandy beach in the tropics where the molluscan fauna is chiefly bivalve, we find *Mactra turgida*, *M. carinata*, *Trigona mactroides*, *Donax denticulata*, *D. striata*, and, more rarely, *Venus granulata*, *Cytherea dione*, and a few Tellens. In the deposits at Matura we have, however, Shells characteristic of a certain depth of water, such as *Terebra*, *Oliva*, *Marginella*, *Conus*, *Erato*, *Chemnitzia*, *Eulima*, *Odostomia*, *Cæcum*, *Dentalium*, &c., and several of the Conchifera. The only strictly littoral Gasteropod in this collection —namely, *Chiton*—is represented by a solitary plate. As to the two freshwater species, each of which is represented by a single example, they may have been borne out, on floating wood or otherwise, from some stream of the neighbouring land.

The comparative numbers of the individuals of each species found in the fossil and recent conditions is another matter which deserves some consideration, though I cannot make many complete and accurate observations on that head. The little Rice-shell, *Oliva oryza*, seems to have been almost as common during the deposition of the Matura beds as at present; while the *Astarte* (*Gouldia*) *Martinicensis* is much more rare now than it appears to have been formerly. This small shell occurs in immense numbers in the Matura deposit. *Corbula pygmæa* is not quite so numerously represented; it is by no means rare in some localities at the present day, but it is second only to the *Astarte* before mentioned, in point of numbers, in the Matura deposit.

§ 4. *Climate of the Period of Deposition.*—Bearing in mind what has been said respecting the proportion of recent and extinct species, it will appear that these deposits probably belong to an epoch not far removed from that of the Glacial and Preglacial beds of Europe. But the extremely small size of the fossils found at Matura is one of the most remarkable features of the deposit. Even where the Shells belong to recent types of average size, the fossil representatives are almost invariably dwarfed. There are only one or two exceptions to this rule; e.g., *Cardium isocardium*, *Turritella imbricata*, and *Bulla striata*, which attain an ordinary, but not a large, growth.

Where the fossil Shells belong to recent types of small size and Arctic genera, they are not smaller than their living representatives. As examples of this, I may cite *Astarte* (*Gouldia*) *Martinicensis*, the *Corbulæ*, the *Leda*, and the *Nuculæ*.

I have been led, by a consideration of the above facts, to enquire whether the refrigeration caused by the extension of glacial action southwards during the Newer Pliocene Period may not have affected lands situated so far south and so near the equator as Trinidad. And it must be confessed, considering the general aspect of the organic remains from the Matura beds, their small size, and the probable contemporaneity of the period of their deposition with the Glacial Epoch in Europe and North America, that there is some likelihood that glacial influences had a share in the modification of this fauna. The influence of climate seems to show itself in the numerical preponderance of individuals belonging to species of Arctic or Northern types, and in the diminutive size generally of the Shells, rather than in the presence of Arctic species.

§ 5. *Relations with other Trinidad Deposits.*—Several of the species found in the Matura beds are identical with those occurring in the Tamana series; and there are also specific affinities with the other Tertiaries of the Island, as mentioned in § 2. But it does not seem, from the lists* given by the Geological Survey, that there is anywhere, as far as has been discovered, the same assemblage of species. The number of recent forms in the beds under consideration forbids us, however, to assign an older date than the 'upper part of the Newer Parian' to them: and, further, the shells from the deposits described in the Geological Report do not possess that general feature of diminutiveness which is so remarkable in the Matura fossils. The Ark found so abundantly in most of the Tertiary deposits of this Island (*Arca incongrua* of the Geological Survey) seems to be absent from the Matura beds. Further researches will be required to show how far some of the species of Arctic types now existing in the West Indian seas may have commenced their existence in the tropics, from the date of the supposed glacial influences.

There is a ferruginous conglomerate at Saline Bay, some little distance north of the exposed part of the Matura deposits, which may possibly belong to the same period as the latter; but it seems to be unfossiliferous.

§ 6. *Concluding Remarks.*—The facts relative to the Matura deposits may be of great interest and importance, when our knowledge shall have been far enough advanced to enable us to pronounce with some degree of certainty on the physical changes of this part of South America in late geological epochs. There is a great deal to be done in this respect. Before any set of conclusions can be established firmly, the observations on which they have been founded must be confirmed by prolonged investigation. There is, however, an interest of its own attaching to the explorations of our Later Tertiaries; and with regard to the Matura deposit, I may quote the very apposite remark of Mr. James Smith, of Jordanhill,—'As it belongs to one of the first steps in the descending series, every circumstance connected with it should be carefully observed and recorded, that researches into the more ancient formations may be conducted with greater success:'[*] and, in addition, it is probable that important inferences with respect to the climate of the earth in former epochs may flow from comparisons such as those attempted in the present paper.

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* Report on the Geology of Trinidad, pp. 163-6.

I shall conclude with a few remarks in connection with the possibility of a colder climate having prevailed in the West Indies during the Newer Pliocene period. It is known that species of Cryptogamic Plants found in the Arctic regions have been discovered on mountains in the torrid zone. Plants indigenous to Lapland have been observed on the Peak of Teneriffe, and on the Blue Mountains in Jamaica. Similar facts have been noticed relative to the Andes.[†] It remains to be seen how far these phenomena are attributable to the former prevalence of colder climates over large portions of the earth's surface. It is possible that the plants referred to may have first appeared within the tropics during a period when the climate was colder than at present; and that when the conditions of temperature became altered, these plants receded from the lowlands, ultimately occupying only the higher summits of the mountains. There is, however, nothing to show that the climate of the torrid zone was ever such that ice could have been present in quantity.

The idea of those alterations in the climate of the earth which are admitted on all hands to have taken place having been widely spread, is not now brought forward for the first time, and hypotheses in explanation have been suggested by various observers. There may even have been more than one period of comparative coldness, and the phenomena may have recurred according to definite and fixed laws.[‡] Again, the climates of the globe might have been such, that while the southern hemisphere was enjoying more than an average share of warmth, the climate of the northern portions of the globe was in a corresponding degree colder; and *vice versâ.* But to do more than merely to allude to what has been brought forward on these subjects, is beyond the scope of a paper like the present.

In the above paper I have confined myself to a very few remarks on those species of the *Mollusca* from the Matura beds which are probably new. I have done so, because I do not yet feel justified in publishing new specific names. There are no means of reference, either to Museums or to published works, in this island. Our Public Library scarcely possesses any but the most elementary works on Natural Science.[§] It is, however, but fair to state that the Governors of the Colony have not always been indifferent to the claims of science; and it may be hoped that the time is not far distant when some efforts will be made for the institution of a local Museum and Scientific Library.

PORT OF SPAIN, TRINIDAD: *August* 1864.

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[*] Smith, Post-Tertiary Geology, p. 5.

[†] Humboldt, Travels (Bohn's ed. 1852), vol. i. p. 115.

[‡] Page, Past and Present Life of the Globe, p. 190.

[§] See Crüger in Geological Report on Trinidad, p. 176.

VI. ON THE SIGNIFICANCE OF THE SEQUENCE OF ROCKS AND FOSSILS: THEORETICAL CONSIDERATIONS ON THE UPPER SECONDARY ROCKS, AS SEEN IN THE SECTION AT ELY.*

By HARRY SEELEY, Esq., F.G.S., Woodwardian Museum, Cambridge.

CLAYS are generally the mud of rivers; sandstones, the detritus of old crystalline rocks; while limestones are organically or chemically formed. If, therefore, there is a great clay, it bespeaks a great river draining lands that were; though small and local clay-bands may be but the ruins of denuded sea-cliffs. The sandstone is the evidence of coast and reef, where weather and wave disintegrated plutonic rocks, or constructed over again the palæozoic or older sand-rocks. And limestones have been formed either where the land had sunk, or where the material was derived from the denudation of calcareous cliffs in shallow seas.

The physical significance of many beds may be gleaned from application of these principles; and in a rude way an approximation may be made not only to the relations of land and water in former times, but to the order and places in which changes of level were made.

It is worth notice, that while the Cretaceous clay alternates with sandstones, the Oolitic clays for the most part alternate with limestones. These Lower Secondary limestones appear to have been partly derived from pre-existing calcareous beds; partly to be owing to rivers flowing through limestones; and are partly organic. So, as will be seen, they indicate features of physical geography unlike what afterwards obtained in the Upper Secondary strata; and it seems that important changes of level, bringing a new series of rocks into wear, marked the incoming of the Cretaceous rocks and fossils.

To understand the lithology and palæontology of any bed, it is necessary to remember *why* the deposit exists; since it may include several different rocks; or different deposits may be included under the same rock. This may be illustrated by some old physical changes in the Cambridgeshire district.

Under that northern extension of the Upper Greensand, the Hunstanton Red Rock, there is a deposit, which at Speeton and Huns'ton rests on the Kimmeridge Clay. At Speeton this is the Speeton Clay, which, Professor Phillips assures me, represents continuously in one stratum the Shanklin Sands and the Gault. And the Huns'ton Rock, which is there aluminous, being above, the whole succession is perfect to the Chalk. Now at Huns'ton, instead of a clay between the Red Rock and the Kimmeridge Clay, there are sands; and the Red Rock, instead of being aluminous, is sandy. The fossils of this *Carstone*, as it is called, are few. Those from its base might well belong to the Shanklin Sands; but species from the upper part, like *Ammonites splendens*, are such as would rather be associated with the Gault. It is therefore far from unlikely that at

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* This paper was read March 7, 1864, before the Philosophical Society of Cambridge.

Huns'ton the upper part of the Carstone may replace the Gault, just as at Speeton the lower part of the Speeton Clay replaces the Shanklin Sands. The passage from the Huns'ton Brown Sands of the Carstone to the Huns'ton Red Rock is as gradual as could be; and the intimate physical connection of the two beds has been remarked in another paper. And, seeing how rarely a member of the Cretaceous system is wanting in any other district of England, it is *à priori* far more likely to be present than wanting.

All that its presence would imply is that the palæozoic rocks, the detritus of which furnished the Shanklin Sands, were still in one district being denuded long after they were depressed everywhere else; exactly as the Speeton Clay indicates that the great continent (to the existence of which the Kimmeridge Clay testifies, like the other clays) by upheaval became drained by a smaller river, which at length, by other changes of level, became supplemented by another and larger river, the mud brought down by which formed the Gault. The Lias, Oxford Clay, Kimmeridge Clay, Gault, London Clay, and the Thames, to me all testify to the same great river-valley in a vast Atlantic continent gradually being drained by a smaller and smaller stream, and reappearing changed and smaller in successive rhythmic intervals. The Speeton and Weald Clays were from exceptional smaller rivers in the same continent. And since the Carstone cannot be all Shanklin Sands, it must imply that, when the eastern part of the palæozoic continent sank down, a small island of Carboniferous and such-like rocks still remained, and by the falling of its cliffs continued through the time of the Gault the same detritus as accumulated the Shanklin Rocks. Moreover, as the Gault and the Speeton Clay do not become continuous, their separation bespeaks the same intervening land.

The Gault in the section at Ely is so thin, because Ely was near the extreme limit of the fine mud which the river carried to sea; and, as the river would silt up in time, the mud eventually would not be carried so far; and this would account for the newer part of the Gault being wanting, and for the unconformability of the Greensand.

Then, during the Upper Greensand period, there comes a partial return to the causation which produced the Shanklin Sands. The sea-bottom is upheaved until granites and hornstones, quartzites and sandstones, come within the power of the breakers. Cambridgeshire has become a shallow shore, seemingly within the tides, where scarcely any sediment is brought, and remaining nearly stationary. Then, when the level changes again, the old continent passes altogether away.

Scarcely anything in the whole of Geology is more remarkable than the succession of the Secondary rocks. They run, roughly, omitting the New Red Sandstone, clay and limestone three times repeated; and then sandstones, clay, and sandstones. And these oscillations are so worthy of notice, because indicating changes in the sea-bottom, which must have affected its ocean-inhabitants. The depression of the Shanklin Sands necessitated the migration away of the fauna. And with the upheaval of the Greensand, some of the animals came back again. The migration away of any given fauna, expelled from its home by physical causes, can only be at the expense of another, on whose feeding-ground it encroaches. In the struggle for life the weaker die off; and some in their new conditions put on new characters, so that out of two provinces fusing there comes to be a new fauna in the region.

The operation of elevation and depression, in this way might produce all the phenomena of existing life-provinces on land and by sea; and similar life-provinces in past time. And the cause of difference of fossils in different beds seems to be merely the immigration of a new province, consequent on changes of land and water; and, except in proving this change, fossils are no evidence whatever of duration of time. No science can tell how long any species may endure unchanged. If elevations are made in successive undulations, as they appear to be, there might, with scarcely a break in time, be as entire a break in life as between the Palæozoic and the Secondary strata. Palæozoic, Mesozoic, and Tertiary are convenient fictions; but all they mean is—that by repeated change of level certain groups of nearly related provinces of life in the sea came to be successively fossilized; they mean too that, besides the minor oscillations, like those of the strata, there have been preserved the records of three grand revolutions.

In the Greensand, though the conditions are greatly changed, many of the Gault fossils are again met. But the phosphate-bed of Cambridge reproduces over again the phosphate-bed of Folkstone, which, if of plant-origin, may easily have continued through the whole Gault period somewhere. For in the Cambridge Greensand the Crustacea and many a Shell, absent during the Upper Gault, which I believed only travelled along shore, have migrated back again, in company with strange and unknown associates: two provinces of the old Gault-sea blended, and made the Greensand fauna; or the blending may have already taken place in an adjoining province. And all the existing life-provinces appear to me to be the result of such blending and cross-blending and change, brought about by upheaval and depression of lands and sea-bottoms during old geological periods. By examination of the fossil species, and of their recent representatives, I have been able in many cases to discover whence fossil species did and did not come from, and to get an insight into unexpected physical changes: these will be embodied in maps of the old-world and its former distribution of life in provinces.

The change of lithology is a greater evidence of an interval of time between the Gault and the Upper Greensand, than the partial community of fossils is evidence of the absence of any interval. Then, on the other hand, though there is clearly not the slightest break in time between the Upper Greensand and Chalk, there is almost an entire change in fossils. This change in life indicates no gap in time. But the lithology of the Chalk indicates changed physical conditions; thus the flat wide shore of the Greensand has changed its place; and the animals have followed their 'unhastingunresting' home. And in this change the sea has deepened; and, while the shore-animals were left above, a new feeding-ground was thus opened to immigration from a new province and a deeper zone.

It is worth notice that the species of Gasteropods and Cephalopods which are generically similar to those of the Greensand occur here only in the lowest beds of the Chalk; which indicates rather a deeper zone than a changed province. In Mr. Whitaker's 'Chalk-rock' many of them reappear; and I therefore regard the fauna of that singular stratum as the result, among other causes, of a temporary and partial uplifting.

The change from Shanklin Sands to Gault was one of depression; but from Gault to Greensand was upheaval; and from Greensand to Chalk it was depression again.

ABSTRACTS OF FOREIGN MEMOIRS.

GEOLOGY OF THE HIMALAYAS.

DR. F. STOLICZKA has recently communicated to the Academy of Sciences, Vienna, a brief account of his expedition to the Valley of Spiti and the upper regions of the Himalayan Chain. He intended to traverse a part of the province of Tchou-Tchou, but this project had to be abandoned, because the natives opposed the passage of Dr. Stoliczka and his companion traveller, Mr. J. Mallet, of the Geological Survey of India, with the thirty-six coolies and ten soldiers in their service. The Himalayas were crossed by the Parang-Là Pass,* 19,000 feet above the level of the sea, between the Sutlej and the Indus. The geological end in view was successfully attained. The existence of nine different formations has been determined in the Spiti Valley, where only two were previously known. The SILURIAN formation extends to the defile of Bhaleh, where it disappears beneath the CARBONIFEROUS strata, easily recognized by their fossils. Above the latter, the formations succeed in the following order:—

1. Well-developed TRIASSIC limestones with *Halobia Lommeli*, *Orthoceras*, *Auloceras*, *Ammonites* of the group *Globosi*, and numerous *Brachiopoda*.
2. Bituminous limestones, containing a large thick-shelled bivalve, *Megalodus triqueter*. These limestones represent probably the Rhætic series.
3. 'Limestones of the Pass of Parang-Là,' very analogous to the Hierlatz beds† of the Alps, rich in *Brachiopoda*, and containing *Belemnites* and some rare *Ammonites*.
4. Black Shales, with concretions, already known by their remains of *Cephalopoda*.

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* Lat. 33° N., long. 78° E.

† The Hierlatz beds are of the age of the Middle Lias, and contain fossils chiefly characteristic of the zone of *Am. margaritatus*.—R. T.

5. Yellow sandy limestones with ***Avicula echinata*** **and** ***Opis*****, probably equivalent with Jurassic beds of Nattheim,[*] Wurtemberg.**
6. Limestone with ***Nodosaria, Dentalina, Cristellaria*****, and fragments of** ***Rudistes*****, on which are superimposed calcareous marls without fossils. These deposits indicate the presence of the Cretaceous system, hitherto unrecognized in the Chain of the Himalayas, but known in Persia.**

The expedition suffered very much by the want of water and provisions, as also from the cold. The flora and fauna were found to be excessively poor; the terrestrial Mollusca in the Spiti Valley are represented by only three species of *Helix*, one *Pupa*, and a *Limnæa*. —From '*L'Institut*,' April. R. T.

SOME NEW TERTIARY FOSSILS. By Dr. LOEW.

(Proceedings of the Imperial Geological Institute, Vienna, June 21, 1864.)

THESE have been found in the Cerithian Sands of Nussdorf (NW. of Vienna), intercalated between brackish plastic clay. Among them are two species of *Paludina* (*P. ventrosa*, Mont., and *P. Baltica*, Nils.), both now inhabiting brackish waters, the first on the coasts of the Channel, the other in the Baltic, and an undetermined species of *Pupa*, the first representative of this genus hitherto found in Tertiary deposits. With these shells were found a number of seeds of a species of *Celtis*, of the rusty colour common to all organic remains preserved in the Cerithian Sands. They are hollow in their interior, fragile, and evidently inferior in size to those of *Celtis australis* and *Celtis occidentalis*. The characteristic reticulation of their surfaces being more or less rubbed off, it is hardly possible to state to which of the two living species, *C. australis* (a native of the European and African coasts of the Mediterranean, also said to occur on the mountains of Tyrol, Carniola, Styria, and Hungary), or *Celtis occidentalis* (a native of the south of Northern America), they must be referred. COUNT M.

REVIEWS.

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THE APPLICATIONS OF GEOLOGY TO THE ARTS AND MANUFACTURES. Being Six Lectures on Practical Geology, delivered before the Society of Arts, as a part of the Cantor Series of Lectures for 1865. By Professor D. T. ANSTED, M.A., F.R.S. London: HARDWICKE. 1865.

THE attempt commenced some years ago by the Society of Arts to ascertain and organize the Lecture-giving power of the scientific community seems to have been successful in some respects, and to have obtained recognition of success in a most satisfactory form. The celebrated Dr. Cantor, of the E. I. Medical Service, bequeathed half his residuary estate to the Society, for the promotion of its objects; and the Society has employed the proceeds in establishing Courses of Lectures on the Application of Science to the Arts. The talent for lecturing, however, is by no means common in this country, and the power of exhibiting a subject in a popular form is for the most part inversely proportioned to the learning and experience of the lecturer.

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[*] Of the age of the Coral-rag.—T. R.

As a Professional Geologist, Prof. Ansted stands nearly alone, both as regards his disconnection from all Government offices, and his experience in delivering courses of lectures in which geological topics are treated as matters of business, and not as media for jokes. His 'Geological Gossip,' published in 1860, contained eighteen shorter essays on subjects similar to those which occupy the present volume. These relate for the most part to subjects of the day, such as water-supply, the manufacture of cements and artificial stones, fossil fuel, and the connection between Agriculture and Geology. The regular Text-books cannot be expected to give much information on these economical questions; for whatever is said requires frequent change: but they are good subjects for courses of periodic lectures.

Agricultural Geology is just now under a cloud. At the Royal College they find it as much as they can do to get lecturers to come and discourse periodically on pure science. But they have an excellent resident Chemist, who, if he enjoyed any sort of relation to the Government, might save us from the great cost of the proposed works for the manufacture of sulphuretted hydrogen in the Maplin Sands.

It would seem time also for Government to regulate by some general principle the rights of proprietorship in Springs. When the attempt was lately made to take the head-waters of the Thames and divert them into Sabrina's Valley (for the benefit of the Old Indians who inhabit those parts), the Conservators of the Thames cried out lustily, and greatly exaggerated the loss of volume it would sustain; but it is only reasonable to respect Nature's division of the country into hydrographical areas, and to allow the inhabitants of each to make the best use they can of their own rain-fall.

The manufacture of artificial stone has not yet attained perfection. The failure of Prof. Kuhlman's water-glass led to the experiments of Messrs. Ransome, who have produced a porous material well adapted for filtering other materials sharp enough for whetstones and grindstones, and artificial sandstone in blocks of sufficient size and strength for supporting heavy engines or any other purposes. But they have never entirely succeeded in freeing this stone from soluble and deliquescent salts which continue to effloresce from the surface, or render it damp. Even the process described by Prof. Ansted as the last and perfectly successful has been considerably improved upon; and we trust now that the 'Stone Company (limited)' will only need unlimited orders to attain equal success. As those who read Prof. Ansted's remarks on cements are most likely to deal with them on a small scale, we will mention, as the result of our personal experience, that 'Roman Cement' and 'Portland Cement' are equally good in situations which remain permanently damp, but are unsuitable for dry places; and 'Portland Cement,' being caustic, is pleasant neither to the fingers, nor to the curly inhabitants of an aquarium.

A CATALOGUE OF THE COLLECTION OF FOSSILS IN THE MUSEUM OF GEOLOGY, WITH AN EXPLANATORY INTRODUCTION. By THOMAS H. HUXLEY, F.R.S., Lecturer on Natural History in the Royal School of Mines; and ROBERT ETHERIDGE, F.G.S., Palæontologist. 1865.

FOR upwards of twenty years the Geological Surveyors have been carefully collecting, sorting, and arranging British Fossils in such wise that, with perseverance, judgment, and science, they have now obtained for the Nation so fair and complete a Collection that every successional group, and every local development, of strata is clearly illustrated by its organic remains in the Museum of Practical Geology, commenced by De la Beche at Craig's Court, since placed in Jermyn Street, and enriched with a noble series of the fossils and minerals, mineral products, and mining appliances, not only of Great Britain and the Colonies, but of all other parts of the world, as far as necessary for the purposes of a National School of Mines, and one of the most careful and elaborate of Geological Surveys.

Descriptive Catalogues of the Musuem generally, and of the Rock-specimens, by Robert Hunt, A. C. Ramsay, and their assistants, have long since appeared, and been reproduced with additions; and now we have a full Catalogue of the multitude of Fossils—the 'Medals of Creation,' far more numerous than any numismatic series, far more intricate in their relationships, often more difficult to decipher, and as valuable to miners, farmers, and all who have to do with the stony structure of the earth, as coins are to the historian.

The care, knowledge, and judicious discrimination indicated by the 380 pages of well-determined names of so many selected fossils, either collected by the Survey, or presented by private geologists, are associated with the clear-sighted and well-applied philosophy of the 'Preliminary Considerations' on the meaning and value of Fossils, and on the study of Palæontology, or Science of Ancient Beings; together with a 'Brief Exposition of certain principles of Natural History,' and the 'Applications of Natural History to the elucidation of Fossils or Palæontology,' including a brief but interesting summary of the geological history of Animals and Plants, especially with reference to the long persistence of several orders, and the absence of any definite proof of a progressive development of animal and vegetable life having existed, as far as fossils show. A Table of the Classes and Orders of the Animal Kingdom (excepting soft animals), and a Table of the Fossiliferous Rocks, accompany this Preface.

ON THE RIVERS AND PLAINS OF CANTERBURY, NEW ZEALAND.
By W. T. DOYNE, Esq.

IN Reporting to the Secretary for Public Works, Christchurch, Canterbury, New Zealand, in June 1864, on the selection of a site for a bridge over the Rakaia, on the prevention of further encroachment of the Waimakariri on Kaiapoi Island, and on turning a creek of the Rangitata, Mr. W. T. Doyne* states that these three rivers, taking their rise high up in the mountains, and chiefly fed by snow and glaciers, are necessarily very fluctuating, higher in summer than in winter, and apparently more affected by hot north-westerly winds than by rain. Though generally fordable, they form, in their 'freshes,' torrents of great power, spreading over shingle-beds from one to two miles wide, and at places cutting new channels to the depth of 20 feet. In the mountains, for 40 or 50 miles, each river cuts out and washes down great quantities of boulders, gravel, and sand, carrying it out through the gorges, along the river-courses, to the sea; a portion being deposited on the way, according to the diminishing force of the stream, either from less fall or increased width. The material in the river-beds is all siliceous, greatly water-worn, and in every variety of size and form, from impalpable dust to boulders measuring two cubic feet. As this shingle accumulates in the bed of the stream, the water is thrown off against the low banks of similar material; and these being quickly undermined, the river widens out until it has no power to carry forward any but the lightest sand and mud. Thus barriers rise several miles in length, raising the bed of the river above the banks, and making it overflow; until before long it cuts out a new course, deepening and widening it, until the old course is completely left and restored to the plains; the new channel becoming the true river. In time this course goes through the same changes, and it again is filled up. As the plains diminish in fall towards the sea, this tendency on the part of the rivers to fill up their beds increases; and in this way all these rivers are now so gorged, that they cannot move the shingle forward beyond a point about fifteen miles from the sea. At this point each river must now overflow its banks, and find a vent in new channels, unless prevented from so doing by considerable engineering works. The rivers differ, of course, in their volume of water and in the fall of their beds; but Mr. Doyne arrives at this conclusion, that, when the inclination of the river-bed, composed of shingle and sand (as in the Rakaia and Rangitata), is less than 24 feet in a mile, the space over which these rivers can change their courses must be confined to within half a mile in order to keep the course open. Where the river runs through silt and clay, a much less fall is required, as with the Waimakariri near its mouth. He believes that the Canterbury Plains, extending from NE. to SW. for 100 miles, with a width of from 30 to 40 miles from the sea-coast to the foot of the mountains, may be looked upon as the delta of these great rivers, having their mouths at the gorges where they discharge their waters at the mountain-base; and that they have through a long period accummulated at least 80 feet of detritus in these plains. Old river-beds are traceable on the surface, each river having often changed its course. The Waimakariri has been most changeable, and for a long time seems to have been moving north, having within a comparatively recent period traversed the distance of about 28 miles,—between the Selwyn and its present course. These rivers are therefore only doing now what they have often done before, and will continue to do until the mountains wear into hills and downs.

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* In the 'Press,' Christchurch, N. Z., for July 1864.

Mr. Doyne recommends a site for the bridge above where shingle and sand, raising the river-bed of the Rakaia, make it overflow; he recommends the overflow channel of the Rangitata to be left alone; and he points out also that the Government had better leave Nature to work out her ends with the other river, and rather indemnify the farmers of Kaiapoi year by year as the land goes, than waste money in making a railway bridge in a wrong place, and constructing useless works of great magnitude and certain failure.

There are other points of interest shown by Mr. Doyne. The engineering plans referred to by him seem to show that the rivers first followed the lowest or level course through the plains, and that, as they have been choked with shingle, they have deviated at right angles to these lines of level courses, which are 25°–27° E. of magnetic N. for the Rangitata and Rakaia, and 16° 30′ W. of magnetic N. for the Waimakariri. Hence the direction of future overflows can be indicated. Should the latter river break its south bank, it might seriously affect Christchurch; but accurate levels have to be taken as a basis for calculations in this matter, and would add much to a knowledge of the river's history. The constant tendency of these rivers in their changes to go northerly would lead (Mr. Doyne thinks) to the conclusion that there has been a steady upheaval of the land in the neighbourhood of Banks's Peninsula and south of it.

THE GEOLOGY OF NEW ZEALAND.

SINCE 1843, when Dieffenbach's 'Travels in New Zealand' were published, nearly every year has contributed some information about the minerals and fossils of that country, and about its volcanoes, hot-springs, glaciers, gold-fields, and general geology. In 1859, the Austrian circumnavigators, in the 'Novara,' having visited New Zealand, one of them, Dr. F. von Hochstetter, was induced to spend some time in a special geological examination of the Provinces of Auckland and Nelson; and one portion of the results is given in his handsome quarto, 'Geologie von Neu-Seeland: Beiträge zur Geologie der Provinzen Auckland und Nelson (Novara-Expedition, Geologischer Theil, I. Band, I. Abtheilung),' 1864, illustrated with six coloured geological maps, eight plates of views, and sixty-six woodcuts; whilst a Geological Atlas and Palæontological Memoirs (noticed in GEOLOGICAL MAGAZINE, Vol. I. p. 73) are other portions of this noble work, divided among several eminent naturalists. Before then Auckland had its Provincial Surveyor, Mr. C. Heaphy, at work, whose papers appeared in the London Geological Society's Journal; and Dr. Julius Haast soon after entered the field as Provincial Geologist at Nelson and Canterbury; and his observations, particularly on the glaciers, moraines, mountain-gorges, and formation of the great river-flats, have been printed in New Zealand, Victoria, and England. His 'Report on the Geological Survey of the Province of Canterbury,' 1864; his 'Report on the formation of the Canterbury Plains,' 1864; and his remarks on the glacial conditions of New Zealand (in the Geological Society's Journal, May 1, 1865), are now before us. The Province of Otago also, one of the first districts in New Zealand to supply geological information, through G. M. and Walter Mantell (in the Geological Society's Journal), is now being thoroughly examined by a first-rate geologist, Dr. James Hector, who has already supplied (Geological Society's Journal, May 1, and the GEOLOGICAL MAGAZINE, November 1864, p. 238) a succinct and masterly sketch of the structure of the region explored by him. His results agree with Dr. Von Hochstetter's, and show that the Three Islands forming New Zealand are parts of one main ridge, formed of crumpled and highly altered strata, probably for the most part Palæozoic, but possibly in part Lower Mesozoic; whilst some Triassic, Jurassic, Tertiary, and Post-tertiary strata form parts of the flanks, and here and there lie at greater elevations. Like North America and other countries, New Zealand is beautifully illustrative of the theory of the formation of mountain-ranges and continents by the elevatory and metamorphic action of lateral crush, arising from contractions on a large scale, repeated through untold ages.

TOURIST'S GUIDE TO LLANGOLLEN AND ITS VICINITY, ETC. By D. C. DAVIES. Third Edit. 12mo. 1864.

NOW that many holiday-makers are thinking of their intended routes and excursions, and there is an increasing number of Tourists who take an interest in Geology, we may remark that in the little Guide-book to the neighbourhood of Llangollen, published by Roberts of that town, there is a satisfactory attempt to explain geologically some of the natural features of the district by one of the Members of the Oswestry Naturalists' Field-club. Some of the names of the fossils are incorrectly spelt; but the geology is well described; and the tourist will learn much from his Guide, if he opens his eyes when on the summit of Dinas Bran, not only to lights and shadows, air-distances, and such like, but to the structural features of 'the conical peaks of the Silurian hills,—the battlemented terraces of the Mountain-limestone,—the heath-clad moor-like surface of the Millstone-grit,—and the North Wales band of the Coal-measures, with its unmistakeable surface-signs, sloping down to and fringing the New Red Sandstone plains of Cheshire and Salop.'

REPORTS AND PROCEEDINGS.

GEOLOGICAL SOCIETY OF LONDON.—I. April 26; W. J. Hamilton, Esq., President, in the chair. The following communications were read:—1. 'On the Character of the Cephalopodous Fauna of the South Indian Cretaceous Rocks.' By Dr. F. Stoliczka. Communicated by the Assistant-Secretary.—In this paper the author gave a summary of the more important facts brought to light by the examination of the Cretaceous Cephalopoda of Southern India, which was begun by Mr. H. F. Blanford, and continued by himself, giving, first of all, a brief notice of what had been done previously by other observers, and a sketch of Mr. Blanford's subdivision of the strata into the Ootatoor (or Lower), the Trichinopoly (or Middle), and the Arrialoor (or Upper) groups. All the genera characteristic of European Cretaceous faunæ were stated to be well represented, the whole assemblage having a Middle Cretaceous aspect. The number of species of the different genera occurring in each of the three subdivisions was then given, as also the distribution of the groups of the genus *Ammonites*, the most striking and abnormal feature being the intimate association of three species of that genus, belonging to the Triassic group 'Globosi,' with true Cretaceous fossils. Dr. Stoliczka then discussed the relation of this Indian fauna to those of the European Cretaceous rocks, and illustrated his remarks by a table showing the geological range in India and in Europe of the species that are common to both areas. He came to the conclusion that for the present the lowest of Mr. Blanford's subdivisions (the Ootatoor group) may be considered to be of the age of the European Gault; while the uppermost (the Arrialoor group) does not seem to correspond to a higher division than D'Orbigny's Sénonien.

2. 'On the Growth of Flos Ferri, or Coralloidal Aragonite.' By W. Wallace, Esq. Communicated by W. W. Smyth, Esq., F.R.S., Sec. G.S.—The author first described the physical features of the Mountains in Westmoreland, and endeavoured to show that they bore certain relations to the geological structure of the country, and that the number and size of the joints varied with the elevation of the rocks, and their position in relation to the valleys. After the formation of the joints, the minerals occurring in the veins in their neighbourhood were stated to be acted upon by decomposing agents, and it was therefore inferred that the amount of decomposition in veins and in rocks is proportional to the amount of their elevation above the sea.

Mr. Wallace then stated that Aragonite is produced only after the strata are traversed by joints, and that the branched Aragonite very rarely occurs, being found only in caverns and old workings. Two of these caverns have come under his notice, and were described in detail; one of them is in the north vein of the Silver Band Mine, and the other near one of the principal veins of the Dufton Fell Mine. Finally, he discussed the causes and conditions necessary to the formation of this Coralloidal Aragonite, and came to the conclusion that the theory of a circulation, through the pores of the spar, of fluids holding its component parts in solution is the only one that harmonizes with the varied phenomena observed in the two caverns he had described.

3. 'Notes on presenting some Rhomboidal Specimens of Ironstone, &c.' By Sir J. F. W. Herschel, Bart., K.C.H., F.R.S., F.G.S., &c. With a Note by Captain T. Longworth Dames. Communicated by Sir C. Lyell, Bart., F.R.S., F.G.S.—Most of these specimens came from a quarry at Clanmullen, near Edenderry, King's County, and the remainder from the Collingwood Quarry, in the Weald of Kent. The Irish specimens are siliceous, containing some oxide of iron and a little manganese, and are homogeneous throughout. They all agree in the sharpness of definition and the exact parallelism and evenness of the flat surfaces; but, like those from the Weald, they are not constant in form or size, and sometimes are very irregular in angle and in the parallelism of opposite sides. The Wealden specimens, however, are all closed boxes, each containing a rhomboid of hardened sandstone, the outer case being highly ferruginous —in fact, the 'Ironstone of the Weald.' Sir John Herschel endeavoured to account for the formation of the boxes, and Captain Dames added a Note stating the circumstances under which the Irish specimens occur.

II. May 10, 1865; W. J. Hamilton, Esq., President, in the chair. The following communications were read:—1. 'On the Azoic and Palæozoic Rocks of Southern New Brunswick.' By G. F. Matthew, Esq. Communicated by Dr. J. W. Dawson, F.R.S., F.G.S.—After briefly narrating the History of the Geology of the region, the author described each of the formations successively in detail; namely, the Laurentian (Portland series), Huronian (Coldbrook group), Lower Silurian (St. John group), Upper Silurian, Middle and Upper Devonian (including the Bloomsbury group, Little River group, and Mispeck group), Lower and Upper Carboniferous. The only important hiatus is, therefore, that wherein the Trenton Limestones and Hudson River Shales should fall, and those formations probably form part of the Lower Silurian rocks already known. Mr. Matthew then stated that it is now a well-established fact, that throughout Palæozoic time the centre of the North American continent was comparatively stable, the whole series of formations being found in continuous and conformable succession, from the base of the Silurian to the summit of the Permian. The stratigraphical peculiarities of the several formations in regard to their mutual relations were next described; and the author inferred the existence of at least three breaks, and possibly a fourth (between the two sections of the Carboniferous system) in the Palæozoic series of Acadia; namely, between the Huronian and the Silurian; between the Lower and Upper Silurian, and between the 'Lower Devonian and Upper Silurian,' and the 'Middle and Upper Devonian.'

2. 'Results of Geological Observations in Baden and Franconia.' By Dr. F. Sandberger, For. Corr. G.S. Communicated by the

President.—In this paper Dr. Sandberger communicated the results he has arrived at by the study of the Palæozoic, Triassic, and Jurassic Beds of Baden and Franconia. The so-called 'transition formation' of the Black Forest he had previously ascertained to be Lower Carboniferous; it is immediately succeeded by the strata of Berghaupten near Offenberg, which also occur in Alsace. Near Oppenau occurs a species of *Pterophyllum*, three feet long, which affords a new proof of the close connection between the Palæozoic and Triassic floras; and to this fact may be added the discovery of a true *Schizopteris* in the Letten-coal of the Trias near Würzburg. This connection Dr. Sandberger also considers more perceptible in the fauna than has hitherto been supposed. The Wellenkalk, Muschelkalk, and Letten-coal appear better developed in Franconia than elsewhere in Germany, and the clearness of the stratification leaves no doubt about the order of succession. Amongst the results of a comparison of the Thüringian and Swabian types with those near Würzburg is the discovery of the fauna of Recoaro and Mickelschütz in the Middle Wellenkalk; and the author remarks that, as the rocks of the Alpine so-called Muschelkalk entirely agree with the Wellenkalk of his district, that rock ought henceforth to be called Wellenkalk; for no representative of the true (Upper) Muschelkalk has hitherto been observed in the Alps. The Jurassic rocks occurring in Baden he refers to the Cornbrash and the Inferior Oolite.

3. 'On the Changes rendered necessary in the Geological Map of South Africa, by recent discoveries of Fossils.' By Dr. R. N. Rubidge, F.G.S. (See also Geol. Mag., No. V. p. 232.) Dr. Rubidge first called attention to a former paper, in which he pointed out the occurrence of horizontal beds of sandstone resting on the upturned edges of gneiss, and continuous with inclined sandstone of like kind interstratified with gneiss. He therefore conjectured that the Clay-slate and Bokkeveldt Schist, which Bain considered distinct, belonged to one formation, that they are of the same age as the gneiss, and that the 'Carboniferous rocks' of the Eastern province were not separable from the Clay-slate, which Mr. Bain had called 'Primitive Clay-slate.' It follows from this that, if the clay-slate proved Devonian, as Dr. Rubidge believed it would, the horizontal quartzite must be much newer, and probably an outlying mass of the Dicynodon-rocks. He explained these phenomena by supposing that rocks of widely different ages had been metamorphosed into masses having the same mineralogical characters. The discovery of certain fossils has lately verified the conjecture respecting the Devonian age of the Clay-slates and Bokkeveldt rocks; and Dr. Rubidge therefore infers that the rest of the old rocks are of the same age. Finally, the discovery of a Calamite in the sandstone, not unlike some specimens belonging to the same genus found in the Dicynodon-rocks, renders the probability of the truth of the second conjecture very great.

Royal Geological Society of Ireland. — May 10th; G. Sanders, Esq., in the chair.—Mr. Jukes read a paper entitled *Notes* *for a Comparison between the Rocks of the South-west of Ireland and those of North Devon and of Rhenish Prussia in the neighbourhood of Coblentz.* Mr. Jukes gave a sketch of the structure of the South of Ireland, with especial reference to the determination of the age of the 'Carboniferous Slate,' and pointed out that in the south-eastern counties the great Carboniferous Limestone and its underlying black shale, or 'Lower Limestone Shale' (transitional from the Old Red Sandstone to the Limestone, and from 20 to 300 feet thick), were together the equivalent of the 'Carboniferous Slate' (from 1,000 to 6,000 feet) and the *included* 'Coomhola Grits' of the South-western counties. The 'Carboniferous Slates' are composed of black shales (often slaty by cleavage) and grey grits; the 'Coomhola Grits' are sometimes local sandstones, but occasionally 2,000 to 3,000 feet thick in the lower part of the Carboniferous Slates. Mr. Jukes referred to the published 'Explanations' of the Geological Survey Map (sheet 187, &c., and sheet 192), in which he had described the Geology, and Mr. Baily the Fossils, for proofs of the 'Carboniferous Slate' and 'Coomhola Grits' being contemporaneous with the 'Carboniferous Limestone,' resting, like it, on the Old Red Sandstone, and covered by the Coal-measures. He believed that they were formed in one and the same sea; mud and sand being deposited in one part, while limestone was being produced in another by the growth of marine animals, especially by forests of Encrinites. In North Devon Mr. Jukes recognizes the 'Carboniferous Slates' and 'Coomhola Grits,' with characters identical with those of Ireland, and passing under Coal-measures identical with those of Cork, Kerry, Limerick, and Clare, which rest on thick Carboniferous Limestone. So also near Coblentz Mr. Jukes was struck with the remarkable identity of the so-called 'Devonian' rocks with the 'Carboniferous Slate' of Cork, and with the presence of red and yellow sandstones like the Upper Old Red of Ireland, whilst the Posidonomya-beds with their coaly seams reminded him of the base of the Irish Coal-measures.

The Rev. Prof. S. HAUGHTON welcomed Mr. Jukes's paper as substantiating the opinions of Irish Geologists, especially as to the non-existence of a 'Devonian System.'—Mr. W. H. BAILY remarked that the limestones of Plymouth, Newton-Bushell, &c., had no equivalent in Ireland, though they had in Nassau; and they might still be regarded as 'Devonian,' being passage-beds between the Silurian and Carboniferous systems.

Mr. SCOTT, on behalf of Dr. CARTE, exhibited a specimen of an antler of *Megaceros*, with the impression of a cannon-bone on its palm; and two jaws of the same animal, which had also rubbed each other by fortuitous juxtaposition in the marl. These were from Limerick, where Mr. Hinckley had also found the specimens formerly described (GEOL. MAG., No. XI. p. 216.)

EDINBURGH GEOLOGICAL SOCIETY.—April 6; David Page, F.R.S.E., F.G.S., Vice-president, in the chair.—Mr. JOHN R. S. HUNTER read a paper *On the Carboniferous Limestones of Carluke,* *and their Fossils*, which was illustrated by vertical sections and a large suite of specimens from the district. After describing the principal physical features of Carluke Parish, which is about 8 miles long by 4½ broad, Mr. Hunter mentioned the occurrence of a very extensive fault in Braidwood Gill, of 80 fathoms, which brought down the Cannel- or Lesmahagow Gas-coal to the horizon of the '*Productus giganteus* Limestone.' He then subdivided the group of Carboniferous Limestones in his parish into three series; namely, (1) the Lower Carboniferous Limestone, or Mountain-limestone, embracing strata from the '*P. giganteus* Limestone' to the '*Lingula*-limestone;' (2) the Middle Coal-measures, from the Gas- or Cannel-coal to the strata immediately above 'Carluke First Coal;' and (3) Upper Carboniferous Limestone, from the 'Climpey Limestone' to the strata above the 'Gair Limestone;' the whole being upwards of 130 fathoms in thickness, and having as superincumbent strata the 'Upper Coal-measures,' comprising the Ell, Main, Splint, and other Coals; while the Lower Coal-measures, again, come below the '*P. giganteus* beds,' and extend to below the '*P. punctatus* beds.' The limestones themselves above the '*P. giganteus* Limestone' were generally persistent, and could be recognized in different and wide localities in the West of Scotland, showing their great horizontal extent. In his own parish there was abundance of limestone to last for ages, for all practical purposes. He then proceeded to notice the various fossil contents of the different beds of limestone, and accompanying shales and ironstone-bands, in an ascending order. The first remains we come to above the Old Red Sandstone are specimens of *Lingula mytiloides*, a cast of a *Bellerophon*, and some indistinct Plant-remains, found by Dr. Selkirk, of Carluke, in ironstone-nodules 33 feet above the Old Red. Then in the '*P. punctatus* beds' of the Lower Coal-measures have been lately found new forms of Entomostraca—*Leperditia*, *Bairdia*, *Cythere*, *Beyrichia*, and others, now being examined by Prof. Jones and Mr. Kirkby. The 'Main Post Limestone' alone, which is not more than from four to six feet thick, has yielded upwards of 160 genera and species, including many new and rare forms. Owing to the occurrence of fissures in this limestone, the sides of which seem to be water-worn, the 'Main Post' is in some places decomposed, and reduced to a very soft and friable state. When in this state, fossils are more easily found in it, and many new species have thus been added to science. Among these are some new Entomostraca provisionally named by Prof. Jones and Mr. Kirkby—*Leperditia Armstrongiana*, *Kirkbya Permiana*, *Bairdia grandis*, *B. brevis*, *B. gracilis*, and 15 others: also a few *Foraminifera*, the first discovered in Scottish Carboniferous strata. Among the rarer species of Mollusca are *Retzia radialis*, *Spirifera pinguis*, *Camarophoria globulina*, *Chonetes polita*, *C. Buchiana*, *Productus Deshayesianus*, *Conocardium armatum*, *Arca Lacordairiana*, *Pleurotomaria altivittata*, *Trochus lepidus*, posterior plate of a *Chiton* (rarely found in British Carboniferous strata), *Porcillia armata*, *Nautilus tuberculatus*, and interiors of *Athyris ambigua*, *Spirifera duplicicosta*, *Productus aculeatus*, and *P. mesolobus*.

Of the last two these are the first interiors found, and have been identified by Mr. Thomas Davidson, F.R.S., F.G.S. Mr. Hunter also exhibited fine remains of *Gyrolepis Rankini* from shale below the 'Main Post Limestone,' and from the 'Rae's Gill beds.' Besides the above, there were exhibited several polished sections of *Lithostrotion*, *Alveolites*, &c.; also several specimens of *Serpulites carbonarius*, *Spirorbis globosus*, *Entomoconchus Scouleri*, and the Trilobite *Griffithides mesotuberculatus* of slightly varied forms, all from the prolific 'Main Post Limestone.' The only Fish-remains found in this limestone are fragments of *Petalodus Hastingsiæ*, *Rhizodus Hibberti*, *Cochliodus magnus*, another species of *Cochliodus*, and a *Pœcilodus*. Only one specimen of *Productus giganteus* was found in the 'Main Post Limestone,' showing that the species was dying out, while only 23 fathoms lower down it is found in great abundance. Above Rae's Gill ironstone, coprolites are found which have yielded many minute bivalved Crustacea, one coprolite alone having yielded 300 specimens of a new species named by Prof. Jones and Mr. Kirkby *Cypridina Rankineana*, after Dr. Rankine of Carluke, who has already added many new forms to the list of species from this locality.

GEOLOGICAL SOCIETY OF GLASGOW.—I. March 30; E. H. Wünsch, Esq., Vice-president, in the chair.—1. ALEXANDER BRYSON, Esq., F.R.S.E., read a paper *On the Insufficiency of the Evidence adduced by Sir Charles Lyell*[*] *to prove the Upheaval of the Shores of the Forth since the Roman Period.* He said, that all the geologists who had written on the subject appeared to have gone into its investigation to support the views of Maclaren, who, though unequalled in Scotland as a topographical observer, had made a series of mistakes, only from his non-acquaintance with general natural history—the habits of marine life in particular. Chambers and Geikie had also formed erroneous conclusions from a like want of preparatory study; and Sir C. Lyell had become the advocate of a theory, suggested by partial and in some cases hurried examination of phenomena, which a careful verification might have convinced him were not only utterly inadequate to sustain it, but were in many instances quite adverse to it. Mr. Bryson referred at considerable length to the various phenomena adduced by Sir C. Lyell and the gentlemen he had quoted, in support of their views, and stated the results of repeated investigations of them by himself and Dr. Bain, which proved that these were not caused by any upheaval of the shores of the Forth, but solely by the deposition of detritus from the various rivers flowing into the Firth, aided by the action of tides and storms. The large deposit of Oyster-shells near Inveravon, 60 feet above the present high-tide level, he attributed to a very high tide and storm-waves in the year 1766, referred to by Boece in his '*Historia Scotorum*,' which had caused a great inundation, destroyed many villages, laid waste the district, and occasioned a great loss of life. In conclusion, Mr. Bryson remarked, as a curious circumstance, that the advocates of the upheaval theory have never sought for confirmation of it on the rocky shores of the many islands of the Firth.

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[*] In the third chapter of his 'Antiquity of Man.'

2. Mr. James W. Young read a paper *On the Presence of Magnesia in Rocks.*—After some remarks on the occurrence and distribution of magnesia and carbonate of magnesia in the crust of the earth, he said that he had been for some time past engaged in examining some of the local limestones, and found that there are very few which do not contain at least considerable traces of it. In Campsie, Ballagan, and Auchenreoch Glens, and at Loch Thom, Renfrewshire, a formation occurs, known as the 'Ballagan Beds.' They consist principally of thin layers of limestone, alternating with beds of a bluish-grey shale. A few remains of Plants and scales of Fishes have been found in a sandstone of the group. They are considered to be the lowest beds of the Carboniferous formation. The following table gives the result of the analysis of the limestones from the various localities. The general composition of the whole of them is similar to that of No. 1. They are of various shades of grey, are compact and amorphous, streak white. The colour is owing partly to protoxide of iron, and partly to organic matter. Where exposed to the air, a reddish tinge is produced, owing to the peroxidation of the iron.

	1	2	3	4	5	6
Sp. Gr. at 15°·5 C.	—	—	2·77	2·75	—	—
Insoluble, principally Clay and Sand	17·2	25·1	12·48	17·88	11·48	6·44
Alumina	1·84	not estimated		—	—	—
Protoxide of Iron	4·30			—	—	—
Lime	30·24	23·06	26·96	25·31	42·30	30·00
Magnesia	11·49	13·36	16·64	14·76	5·16	18·36
Carbonic Acid	34·50	—	—	—	—	—
	99·57	—	—	—	—	—

No. 1, from Campsie Glen, Stirlingshire.
„ 2, „ Gartshake Glen, Dumbartonshire.
„ 3, „ Loch Thom, Renfrewshire.
„ 4, „ Ballagan Glen, Stirlingshire.
„ 5, „ „ „ „ A red variety; effervesced freely with dilute hydrochloric acid; in the grey limestones the effervescence was somewhat feeble.
„ 6. Limestone under trap, Shields' Burn, Campsie.

Another limestone, of Old Red Sandstone age, which occurs at Balgair Moor, Fintry, contains a large proportion of carbonate of magnesia.

	1	2
Carbonate of Lime	53·20	54·18
Carbonate of Magnesia	44·00	45·82
Insoluble	2·36	—
Alumina, with trace of iron	0·60	—
	100·16	100·00

No. 1. Limestone from Fintry.
No. 2. Theoretical composition of dolomite, according to Rammelsberg.

The white layers that are often seen filling up cracks and fissures in coal are generally considered to be carbonate of lime, but considerable quantities of carbonate of iron and carbonate of magnesia are likewise present. The following is the composition of a specimen :—

Carbonate of Iron	19·72
„ of Lime	53·00
„ of Magnesia	18·04
Carbonaceous matter and insoluble	9·24
	100·00

Remarks on the theories respecting the dolomitization of limestones, and on rocks and minerals containing silicate of magnesia, concluded this interesting paper.

II. April 10th (see GEOLOGICAL MAGAZINE for May, p. 219), Mr. G. SOMERVILLE read a paper *On the Geological Features of the Country around Jerusalem*, remarking that a high central tract of limestone runs north and south near the centre of Palestine, forming the water-shed of the country about two miles westward of Jerusalem. According to Lynch, it is 2,700 feet above the Mediterranean on the west; and on the east it rises 4,000 feet above the Jordan Valley and Dead Sea. The hills of Jerusalem, about 600 feet high, consist of Lower Cretaceous limestone, white, flat-bedded, in layers of various thicknesses, containing flint-nodules, and excavated for tombs, and subterranean quarries and water-tanks. These hills and their intervening valleys have evidently been shaped out of the old limestone table-land by the denuding power of water, acting during long periods, and long before the times of history or tradition.

III. The last Monthly Meeting of this Society's Winter-session was held in their Hall, Andersonian University, April 13th; Rev. H. W. Crosskey in the chair.—Mr. JAMES THOMSON exhibited and described a fine collection of Corals from the Lower Carboniferous strata of Linlithgowshire, Lanarkshire, and Ayrshire. Mr. Thomson stated that there were upwards of forty species, chiefly of the genera *Lithodendron*, *Lithostrotion*, *Cyathophyllum*, *Cyathopsis*, and *Clisiophyllum*, their structure being shown by numerous polished longitudinal, diagonal, and cross sections.—Mr. ANDREW ARMOUR exhibited a collection of Fish-remains from the Carboniferous strata of the West of Scotland, including fine remains of *Megalichthys Hibberti*, and an undescribed species of the same genus; of *Rhizodus sauroides*, and of *Cochliodus*, *Petalodus*, and *Ctenodus*, all of which were briefly described.—The Secretary exhibited a specimen of *Peltocaris aptychoides* (Salter), a small Phyllopod Crustacean, from the Graptolite-shale of Moffat.—A section of the Carboniferous beds overlying the Old Red Sandstone at Carluke was exhibited by Mr. HUNTER, Braidwood.—Dr. BRYCE read a paper entitled *Notes on the Earthquake-District of the County of Perth.*—The CHAIRMAN, in closing the present series of Monthly Meetings, congratulated the Society on the value of the papers read, and on the genuine scientific worth of the proceedings, of which he offered a succinct and interesting *résumé.*

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY.—On April 4th, Mr. Silas Bowkley, F.G.S., in the chair, Mr. HENRY JOHNSON read a paper entitled *Suggestions as to the Means of extending the South Staffordshire Coal-field.* This was a continuation of a paper communicated to the Society in 1863, mainly referring to the extended working of the coal-field in the direction of Birmingham and Halesowen. Since the reading of the last paper five new sinkings have been commenced in that district; namely, by Messrs. King and Co., Cradley Park; Swindell and Co., Homer Hill; George Pell and Co., Wassell Grove; New British Iron Company, Hawne; and J. S. Dawes, Manor Farm, Halesowen. It is calculated that, if these sinkings are successful, at least 4,000 acres will be added to the productive area of the coal-field. The district between South Staffordshire and the Shropshire Coal-field, covered with Permian and New Red Sandstone, occupies an area of 357 square miles, or 222,000 acres. This vast tract is bounded on the east by the South Staffordshire western Boundary-fault, which is a down-throw east, and brings in the Permian, with the Coal-measures dipping underneath. On the Shropshire side this tract is bounded by a line of fault, which is a down-throw east. On the whole, the geological conditions of the Shropshire side are quite analogous to the South Staffordshire district,—the Permian resting unconformably on the edges of the Coal-measures. Perhaps the most convenient place for proving this district would be near the Great Western Railway at Albrighton. A shaft of 12 or 14 feet in diameter might be put down 600 to 700 yards for a sum not exceeding £40,000. This might be raised, if the landowners of the district would subscribe 7*s.* 6*d.* per acre upon 110,000 acres. The smaller owners might thus be left out, and still sufficient money be raised; and the proof might be made in three years. The author could speak with confidence, from the fact, that at his suggestion some such project has been adopted in the south end of the Coal-field, and is answering every expectation. The subscribed capital would of course be returned if the trial proved successful. The whole business might be managed by a committee consisting of landowners and coal- and iron-masters, with an efficient staff of practical and energetic officers. If the Coal-measures of South Staffordshire should be proved to extend under this area, the yield is estimated at two thousand millions sterling, and the landowners' royalties would amount to one hundred millions sterling. This district is four times the area of South Staffordshire. These suggestions will probably be ridiculed as purely visionary; but the practical value of the Cannock-Chase Coal, the Riverstone Hæmatite, the Northampton Iron-ore, the North-Welsh Cannel, the Cleveland Iron-ore, were all pooh-poohed in their turn.——The next paper was read by Mr. S. ALLPORT, Birmingham, *On the Dis-*

tribution of Organic Remains in some of the Upper Silurian Rocks. The paper related to two beds of the Upper Silurian series,—the Wenlock or Lower Shale, and the Lower Ludlow or Upper Shale. These are strata of the same lithological character, both being deep-sea formations; and, as far as we can judge, they were deposited under similar circumstances. As they are everywhere found to be conformable with the intervening Wenlock Limestone, and consequently with each other, they appear to form one continuous series. Though these beds have been repeatedly described, we are yet without any complete lists of the fossils of each bed. The lists in the 'Silurian System' are thirty years old, and are consequently out of date. In these tables only two species of Trilobites are given for the Wenlock Shale, and for the Lower Ludlow only three, of which one is wrongly placed, and one common to both measures. There are thus only three species of Trilobites given in these two beds. Thirty species are now known as belonging to these formations. But there is a considerable difference between the fossil contents of the Upper and the Lower Shale. Eighteen species of Trilobites have been found in the Wenlock Shale. From the Lower Shale we have sixteen species; but of these only four species are common to both deposits. Collectors seem generally to have overlooked the fact that when we meet with a well-defined variety or sub-species, in most cases it is not found in the same locality as the parent species, or is not of the same age.

CORK CUVIERIAN SOCIETY.—At the last meeting of this Society for the Session 1864–5, held in the Library of the Royal Cork Institution, Mr. Richard Caulfield, F.S.A., President, in the chair, the President read the following communication on behalf of Prof. HARKNESS, F.R.S.:—A few days ago I received from an engineering student of the College, Mr. Cotterall, fragments of bones and teeth recently obtained from a limestone-quarry at Middleton. Amongst the former I recognized a portion of the frontal bone, including the horn-core, of an extinct form of *Bos*, *B. frontosus* of Prof. Nilsson. This form seems to have been extremely rare in Great Britain, but there are instances of its having been obtained from the marls which underlie the peat-bogs of Ireland. The interest which these bones afford induced me to visit the locality where they were found, to examine the circumstances under which they occur; and, accompanied by Mr. Joseph Wright, on Saturday last, I had an opportunity of inspecting the quarry, and the nature of the deposits which yield the mammal remains. The quarry, which has long been worked, is situated immediately east of the Poor-house Farm, Middleton. The rock consists of the ordinary limestone of the district, in one part much fissured; and under this fissured portion there is a mass of reddish brown clay, the thickness of which cannot be determined, as its base is not seen. This reddish brown clay under the limestone is the deposit which affords the fossil bones, and they are scattered through it, usually in a fragmentary condition, in an irregular manner. Besides fragments of bones and teeth, portions of the horns of Deer occur. These latter are much broken, and do not afford sufficient character to make out the species absolutely. They seem, however, to belong to two forms, one of which had the beam and branches smooth and subcompressed—features which indicate the antlers of the Reindeer; and the other with the horns rounded and rough, a form of surface which marks the antlers of the common Stag. Of these antlers two portions, which appear to have appertained to the Reindeer, have been cut while in a fresh state; and, the faces of the cuts being almost smooth, this cutting seems to have been effected by a fine regular-edged instrument, rather than by a serrated tool. The leg-bones which occur in this clay have *all been broken*, for the most part longitudinally, except the carpal, metacarpal, tarsal, metatarsal, and small bones of the foot. This longitudinal fracturing of the long bones of the leg is not known to occur in any mammalian remains which belong to a period previous to that when we have evidence of the existence of the human race; and these broken bones afford evidence of the occurrence of man, who, for the purpose of obtaining the marrow, divided these bones in the direction most available for this object. Besides evidence of the existence of Man as afforded by the cut antlers and longitudinally split bones, there are other circumstances indicating his occurrence in connection with these remains—one of these, the presence of charred wood, which is equally disseminated through the clay with the bones and teeth. This charred wood is the remains of the ancient fires by means of which former human beings cooked their food; and there also occur equally scattered through the clay detached valves of the common Oyster, upon which Man also had fed.

The circumstances and conditions under which the several animal remains and charred wood are found here fully justify the inference that the cavity in the limestone, in which the clay is now seen, was formerly an open cave, frequented by an ancient race of Men, whose food consisted of a wild, and now extinct, form of Ox; and also of two species of Deer, one of which is now confined to a colder climate than now prevails in the British Isles. This food seems also to have been varied by Oysters. The clay which now fills up this cave appears to have been introduced from above by means of water percolating through the fissures which are so abundant in the limestone here.

We met with no remains of the implements belonging to this ancient Cave-race. This is, however, easily accounted for, as merely the contents of the upper portion of the mud have been brought to light. Future excavations towards the floor of the cave would most probably afford the stone instruments and weapons of this ancient people.

Several objects of antiquity were exhibited and described, by the President and others.

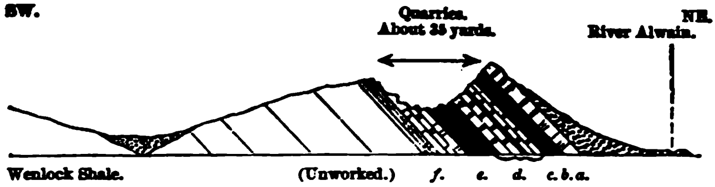
Mr. Robert Day, jun., was elected President for the ensuing year; Mr. Joseph Wright, F.G.S., and Professor Harkness, F.R.S., Vice-presidents.—*Cork Constitution*, May 5, 1865.

CORRESPONDENCE.

THE OUTLIER OF CARBONIFEROUS LIMESTONE NEAR CORWEN, NORTH WALES.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—A day or two may be spent with considerable pleasure and profit, geologically, in the vicinity of Corwen, North Wales, now easily accessible by rail from Llangollen. The hills of Wenlock Shale thereabout may yield fossils if well searched. The 'Tarannon Shale' of the Geological Survey contributes greatly to the boldness of the scenery. Five miles north-west of Corwen, on the Holyhead Road, there is a romantic waterfall in a patch of the 'Bala Limestone,' and diligent hammering in its immediate vicinity will be rewarded by many characteristic fossils. Nearer the village there is an outlier of the Carboniferous Limestone which is well worth the attention of geologists, both for its own peculiar features and fossils, as well as for the relation it bears to the main belt of that formation as it is developed on the North-Wales border.



SECTION OF THE MOUNTAIN-LIMESTONE AT CORWEN.

a. Limestone. *b.* Black shale with nodules, *Rhynchonella*, *Chonetes*, &c. *c.* Band of ferruginous nodules. *d.* Limestone (*Productus giganteus*, &c.), rather arenaceous, and with a shale band in the middle: 45 feet. *e.* Dark bituminous shaley beds, with stone bands, and layers of drifted *Producti*. *f.* Limestone beds, with *Phillipastræa radialis*, *Lithostrotion junceum*, *L. fasciatum*, *Diphyphyllum latiseptatum* (?), and small *Producti* and *Terebratulæ*.

This outlier (see fig.) rises up out of a plain (in the midst of mountains) watered by the Rivers Alwain and Dee, and near to the confluence of the two streams. The locality is called Hafod; and supposing the wooden bridge over the Alwain is not swept away by a flood, as it was when I once visited the spot, you may reach it in about a mile and a half from the village; but, to prevent disappointment, it is better to keep to the Holyhead Road until you have crossed the bridge by which that road is carried over the Alwain, and then, turning immediately to the left, the quarries are reached directly. In order to understand the relation in which the outlier stands to the main band, it will be well to observe that the latter consists, in ascending order—first, of a series of pale-coloured beds, much quarried for fluxing material; second, a number of layers of hard grey limestone; and, thirdly, an alternation of beds of limestone and shale, and black dirt, abounding with fossils. The beds quarried at Corwen correspond to those in the upper portion of the main band; the dirt and shale-beds, together with the fossils found, all serving to confirm the identity. There is a slight lithological difference, however; one portion, marked *d*, differing from beds in the like position in the main band, in the paleness of their colour and the admixture of a considerable quantity of sand; for which reason, by the way, this limestone is not so highly esteemed for agricultural purposes as the former. The beds are perched up at very great angles; the lower beds are not worked; but, by measuring the out-crop of the strata, it is evident that we have the whole series of beds as developed in the main band, corresponding in general order and character, though differing in one or two minor lithological features.

The question arises, does this outlier owe its isolated position to the denudation of beds by which it was once connected with the main band, or to the operation of the same causes which led to the deposition of the latter, *working in a limited area?*—in other words, was it once connected with the main band, or was it originally deposited apart from the rest? The theory of denudation is now in considerable favour; and I find that, in a former number of this Magazine, Mr. Jukes expresses his belief that this very outlier formed part of the 'whole Carboniferous series, which at one time covered a great part of Wales;' the remaining portions, and those once connecting it with the main band, having been washed away. It may savour of presumption to differ from so great an authority; and yet, knowing the country as I do, I am compelled to dissent from such a notion. Let us look a little more closely into the matter. The Carboniferous Limestone of the North Wales border is between 300 and 400 feet in thickness, the bulk of it consisting of limestone proper. The outlier near Corwen is distant about eight miles from the nearest point of the main band. Without assuming, as Mr. Jukes would, that the whole Carboniferous series once covered nearly the whole of North Wales, let us suppose that the main limestone once extended along its whole course of forty miles, eight miles only beyond its present outcrop, we have then a deposit of limestone (to say nothing of the other members of the Carboniferous group), 350 feet or thereabouts in thickness, covering an area of 320 square miles. Now it is quite evident that, if this mass of calcareous matter has been swept away, it has been redeposited somewhere else, in the newer formations. If it has been denuded, have we any indications of the course it took—of the locality where most of it at least would be deposited? Is there in any of the newer formations any deposit analogous to it? Let us see. The pebbles in the Millstone-grit, those in the sandstones of the Coal-measures, those in the Permian and Trias, and notably the materials of the 'Drift' on the Welsh border, and in the plains of Salop and Chester, all indicate currents running eastward. With reference, then, to the particular district under notice, in this direction we should look for this denuded and redeposited matter. And in the extensive plains of Shropshire and Cheshire, which lie between the eastern development of the Carboniferous strata in Derbyshire, Stafford, and South Shropshire, we ought, if anywhere, to find these denuded materials. Now, supposing the denudation to have been slow, we should expect to find similar deposits of limestone and shale formed from the denuded matter; or, supposing the denuding agency to have been strong and the action violent, in that case we should expect fragments and boulders of limestone, and their embedded fossils, together with the solid organisms from the shales, in the redeposited strata. I am bold to say, however, that throughout the whole region referred to, the search would be vain for any such deposits, or beds containing redeposited Carboniferous fossils, while the surface-drift does not contain such a proportion of calcareous elements as would lead us to favour such a theory: indeed, the whole mass of Drift is not more than might be expected to result from the scooping out of the Welsh valleys, mixed up, as it is, with the materials derived from the north. Or, if it should be urged that the redeposited matter has been so acted upon by chemical or other agencies as to destroy its identity, or that it has been carried away nobody knows where—both of which are extreme propositions,—is it at all likely that the solitary remnant of the Carboniferous rocks which once covered the district referred to would be the outlier at Corwen? Is it at all likely that, while all the surrounding strata were swept clean away, this little patch would be left intact, to the very top of the series?—would there not in sheltered spots linger relics of the old time to tell of that which once had been? May we not have reason to expect that, mixed up with the local Drift of the Welsh valleys, there would be no lack of Carboniferous *débris*? Is it at all likely that over so extensive a district 'the house would be swept so clean' as not to leave even a faint trace of its former inhabitants? Yet such is literally the case, if this theory be true. Once passing the outcrop of the main ridges, which, like a line of reefs, sweep round the eastern and northern sides of North Wales, you fail to discern fragments of the Carboniferous rocks in the local Drift, and not a trace of this supposed Carboniferous envelopment occurs *in situ*, save the outlier at Corwen. It may scarcely be admissible as evidence, but I cannot help saying that the general *contour* of the country, and the appearance of the present limestone escarpments, bold and well defined to the very top, capped as they are with their shale and fossiliferous beds, and overlying hills of Millstone-grit, are incompatible (to my mind at least) with the idea that a whole Carboniferous system has been swept away over their heads.

From these, as well as other considerations, though I too may be exposed to the charge of being narrow, and of cherishing 'auld warld' notions of Geology, I must for the present look upon the plain about Corwen as having been once a little inland sea, in which the deposition of the limestone of the outlier went on simultaneously with that of the main band, but apart from the latter.

The search for fossils will be most successful in the shale-beds, both *in situ*, and in the 'heaps' into which these have been thrown out of the way of the quarrymen.

Yours, &c. D. C. Davies.

Oswestry.

LOWER CARBONIFEROUS FOSSILS IN THE COAL-MEASURES.*

MR. R. W. SKIPSEY has asked by letter if Mr. J. Ward (a note from whom appeared in the last No. of the GEOLOGICAL MAGAZINE, p. 234) will be good enough to state if the English discoveries made by himself and the Geological Surveyors have been published; and, if so, where and when. He asks also for the description of the fossils found, the character of their holding-ground, and that of the immediately adjacent strata, as well as the relative position and distance which such ground holds to the Millstone-grit, well enough known to hold some Carboniferous Limestone forms.

Mr. JOHN WARD, writing May 9th, states—'You will find a notice of the discovery of the marine fosils, by Messrs. Hull and Green, in the "Trans. Manchester Geological Society," vol. iii. No. 15, Session 1861–62, p. 348. The fossils are also figured and described by Mr. Salter in Mr. Hull's "Memoir of the Country around Oldham" (Geological Survey Memoirs).

'The fossils I found (Mr. Ward adds) in the Upper Middle Measures at Longton were determined by Mr. Salter as *Lingula* (two species), *Discites falcatus*, *Discina nitida*, *Macrocheilus*, *Aviculopecten*, *Ctenodonta*, and others. The bed I found them in will be passed through again in a few months, when I hope to add many more species to the list.'

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—In the newspapers it is stated that a cottage has been seen to sink wholly into the earth near Tredegar, South Wales, by the collapse of some old coal-mine, certainly, it is stated, 100 feet below. As this seems to offer some support to Mr. Fisher's hypothesis (GEOLOGICAL MAGAZINE, Vol. II., No. III., p. 102) for the formation of the Lexden Pit, by the giving way of the Chalk at about 142 feet below the surface, I think it worth notice.—ENQUIRER.

MISCELLANEOUS.

OBITUARY NOTICE OF HENRY CHRISTY, F.L.S., F.G.S., &c. &c.

HENRY CHRISTY, born July 26, 1810, was the son of William Miller Christy, the inventor of the Penny Receipt-stamp; was a partner in the eminent house of Christy and Co. in Gracechurch Street, and succeeded his father as a Director of the London Joint-Stock Bank. He displayed in commercial matters the same indomitable energy which he afterwards devoted to scientific pursuits. In 1850 he travelled to the East. His turn of mind was then strongly Ethnological, as exhibited by his collection of primitive Eastern fabrics. He also brought from Cyprus an extensive collection of votive figures, now in the British Museum. The great bringing together of the world's products in 1851 powerfully influenced him; and he more and more collected the arms and implements of rude and primitive tribes. In 1852, and also in the following year, he carefully visited Denmark, Sweden, and Norway; and the Collections of Scandinavian antiquities at Stockholm and Copenhagen matured and gave a positive form and character to his investigations in the close resemblance between the lost races of primitive man and the savage life of our time, and in establishing that humanity has in its incipient stage exhibited a singular harmony of expression, not only in its habits and wants, but in the fashioning and ornamentation of its weapons and utensils, quite irrespective of zone and clime. His cabinet—especially formed to elucidate this truth, and in which the relics of the Drift and of the Rock-dwellings of the Dordogne, the lacustrine discoveries from the Swiss Lakes, the antiquities of Scandinavia and of Mexico—in a word, the most varied products of the Flint of Europe and the Obsidian of America—are collated with the handiworks of modern barbaric life, is without a rival.

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* Perhaps some of our readers may have to be reminded that in England the real Coal-measures (those above the Millstone-grit) are divided into Upper, Middle, and Lower; whilst in Scotland the coal-beds associated with the Yoredale Series and Mountain-limestone are termed the Lower Coal-measures; and the Coal-measures proper are referred to as the Upper Coal-measures.—EDITOR.

In 1853 he visited Germany, and made a lengthened stay at Venice with Mr. Cooke, R.A. In 1856 he made an extensive tour through the British North American Possessions and the States, closely examined Cuba, and, there meeting Mr. E. B. Tylor, proceeded to Mexico,—the result greatly adding to his store of knowledge and to the riches of his cabinet. Mr. Tylor's 'Anahuac' (London, 1861) describes their Mexican travels, with life and humour, and is full of interesting details of the natural features of the region, of the remnants of ancient Aztec buildings and works of art, and of the peculiarities of the Indian and Spanish populations. In 1863 Mr. Christy visited Algeria, reaching the Atlas, and visiting Carthage. He was received with marked distinctions, and greatly aided in his object, by the Governor, the Maréchal Duc de Malakoff.

On the 16th April last, he left for Belgium, on a scientific exploration, with some English geologists, and during the hot weather caught a severe pulmonary cold in a cave. On reaching Paris, though far from well, he set off for La Palisse, in the Maconnais district, with his friends M. and Mme. Lartet, though entirely unfit for travelling. There he was attacked with inflammation of the lungs, and, in spite of the care of an eminent Paris physican, Dr. Foville, who did not leave his bedside for a week, he fell a victim to an energy which pooh-poohed all obstacles, and which wore out his bodily frame on the 4th ult.

In association with his friend M. E. Lartet, of Paris, Mr. Christy had devoted much time and labour to the exploration of the caves in the Vezère Valley in Dordogne, and to a scrupulously careful collection of the relics of the prehistoric people that had sheltered therein; and he spared no expense in forwarding this undertaking, which already had resulted in the accumulation of thousands of specimens, all sorted and distinctly labelled. Many selected examples of these cave-deposits have been distributed liberally to various Scientific Societies and Institutions at home and abroad, and many specimens had been lithographed in readiness for publication: indeed, MM. Lartet and Christy had commenced a large work illustrative of these Aquitanian Antiquities; and this, we hope, will be completed by M. Lartet. These fellow-labourers have already supplied the public with preliminary notices of the results of their explorations, in the *Comptes Rendus*, Feb. 29, 1864; the *Revue Archéologique*, April 1864, and the Transactions of the Ethnological Society of London, June 21, 1864; and the Reindeer Period, lying somewhere between the Glacial Epoch and Traditionary Times, has thereby received considerable elucidation at the hands of the palæontologist and ethnologist.

Mr. Christy was well known as a philanthropist. He was especially active during the Irish famine, and his subscriptions were munificent. He delighted to serve others; and no one will know, not even many of the recipients of his kindness, how much was done with the right hand, of which the left was hardly cognizant.

Mr. Christy was a Fellow of many Scientific Societies, and had been selected by the Council of the Royal Society as one of this year's fifteen candidates.—W. T. and T. R. J.

THE celebrated Swiss geologist, M. A. GRESSLY, died in April last, of tetanus. The '*Premier Mars*' says of him, 'he was a child of the people, loved and known by all. Possessing vast knowledge and most profoundly acquainted with the structure of our mountains, yet was he simple and unostentatious. Gressly had no enemies; envy and jealousy had no place in his heart; he was, at it were, an echo of another age. No one was more popular than he in the Jura; from the Perte-du-Rhône to the Rhine there was not a village in which he did not count friends, and where his arrival was not saluted with acclamations.' Gressly was the author of several papers on the geological structure of the Jura Mountains, especially those of his own Canton-Soleure. He furnished Agassiz with a large proportion of the materials for his Molluscan Monographs; and one genus (*Gresslya*, a characteristic Lower Jurassic form) was dedicated to him.*—R. T.

CYCADS and PALMS seem to have been very rare plants in the Carboniferous Period. The only well-authenticated fossil remains of Palm in the Coal-measures are fragments of fronds figured and described lately by Sandberger, as *Palmacites crassinervius* (Flora der oberen Steinkohlenformation im Badischen Schwarzwald, Karlsruhe, 1864, pl. 3); and well-preserved fossil fruits of a Palm, *Gulielmites Permianus*, have been figured and described by Geinitz, from the next succeeding geological formation (the Permian). Of the Cycadeous Plants, *Pterophyllum gonorrhachis*, Goeppert, and *Pt. blechnoides*, Sandberger (Ibid. pl. 2), are the only good specimens known. Dr. Hooker, however, has indicated the existence of the wood of a Cycad in the Coal. *Pterophyllum Cottæanum*, Gutbier, is found in the Permian Marlstone of Saxony, and this genus becomes frequent enough in the Trias and Lias.

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* Translation in part from a Swiss newspaper, April 28th.

THE

GEOLOGICAL MAGAZINE.

No. XIII.—JULY 1865.

GEOLOGICAL PROGRESS.

No. I.

THE completion of the first year's existence of the GEOLOGICAL MAGAZINE affords another opportunity of commenting on some of the leading subjects of discussion amongst geologists. In the first of these articles,* an attempt was made to give, in a few paragraphs, the essential features of the grand results at which geologists had arrived, and the changes which had consequently occurred in regard to the objects as well as the methods of geological enquiry. The second article † was necessarily more special in its object, and was entitled 'On some Points in Geology as seen to-day.' That title is equally applicable to these pages; but, as we hope to publish many similar notices, at more frequent intervals than heretofore, we have preferred to give it a distinctive heading, which will be continued throughout the series. These records of progress are designed to furnish our readers with a concise summary, explanatory and critical, of the topics occupying the attention of the geological world; they will not always be written by the same author, but we shall at all times endeavour to avoid the Advocate, and obtain the Judge.

Our fundamental difficulty lies in the meaning of the term 'progress' as applied to Geology. Our knowledge increases by degrees with reference to the geological structure of different countries, near and distant, and thus it is true we have one kind of progress easily defined; but, in the more alluring paths of Theoretical Geology, unless we reverse the usual practice by considering every new hypothesis to be true until it is disproved, it is impossible to say what is progress and what is not: for geologists are remarkably stubborn and pugnacious;

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* GEOL. MAG., Vol. I. p. 1.

† GEOL. MAG., Vol. II. p. 1.

they will believe nothing, if they cannot see it, until they are obliged, and fight in defence of their scepticism like soldiers for their country.

We have recently seen this characteristic most excellently displayed in several discussions on theoretical subjects, especially in the controversies on the modes of formation of lake-basins and river-valleys. Field-geologists have, indeed, lately aroused from the lethargy in which their theory-forming faculties had so long lingered, and some of them have put forward hypotheses that have excited the remainder to digress for a while from their more general and more profitable occupation of fact-finding. Thus, Professor Ramsay's memoir on the Formation of Lake-basins produced a desultory discussion which commenced three years ago, and still continues. In the April number of the 'Philosophical Magazine,' the enunciator of this theory replied to Sir Charles Lyell's remarks in the new edition of his 'Elements;' but this pamphlet has already been noticed in the GEOLOGICAL MAGAZINE.* More recently,† Mr. John Carrick Moore has shown that Professor Ramsay has been a little forgetful of the laws of dynamics, while many other geologists, including the Presidents of the Geographical and Geological Societies (in their anniversary addresses), Dr. Haast (in the last number of the Geological Society's Journal), and Mr. Ruskin in this Magazine, have taken part in the controversy on behalf of one view or the other, without contributing very much towards its solution. But, in fact, we cannot expect a question of this kind to be definitively solved and settled. It must always remain, for instance, a matter of opinion whether a large rock-basin like that of the Lake of Geneva was or was not scooped out by glaciers, unless some mathematician of acknowledged authority steps forward and proves that ice could *not* perform such a feat. For if it were absolutely proved that ice *could* scoop out a hollow in a hard rock, it would still be uncertain, without strong corroboratory evidence, whether this were the mode of formation of any particular rock-basin. Indeed, it is much easier to assail an hypothesis of this kind than to defend it; and accordingly the several lines of argument adopted by its opponents appear much stronger than the arguments hitherto put forward in its favour, as in many cases Professor Ramsay and his adherents cannot, from the nature of the objections advanced by those opposed to his theory, bring forward facts in direct contravention of them. Such is the case, for instance, in regard to the alleged incapacity of a glacier to excavate a deep rock-basin after it has emerged from a deep and narrow valley into a broad plain, the more especially as Professor Ramsay must admit the diminution in the velocity, and consequently (under such circumstances) in the excavating power of the glacier after this emersion. But this remark will not apply to another objection, lately brought forward by M. Desor in his work 'Die Gebirgsbau der Alpen,' namely, that the great lake-basins existed *before* the Glacial period; for it seems quite as easy for Professor Ramsay to get evidence against this conclusion as for M. Desor to do so in its favour. Whatever may be the issue of this controversy, we have the satisfaction of knowing that, like others of its kind, it will have been the means of bringing to light a host of important facts that otherwise might have remained unpublished; and we hope it may continue as long as it produces such fruit.

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* Vol. II. p. 212. † Phil. Mag., June 1865, Supplement number, p. 526.

Another subject has lately occupied the attention of Swiss Geologists, in addition to that just noticed, though somewhat connected with it, namely, the mode of formation of the Alps. The opinion seems to be gaining ground, that this mass of mountains is the result of a number of independent upheavals of strata at isolated points; that there is no such thing as the Alpine 'Chain,' but that the Alps consist of several mountains, or central masses' as they are termed, grouped together more or less irregularly. These 'central masses' are formed of hard crystalline rocks, such as gneiss, mica-schist, hornblende-schist, &c.; and the intermediate valleys consist of newer and softer material, chiefly clay-slate of different ages. This theory assumes, of course, that the Alpine valleys are essentially valleys of elevation, and not of denudation. But for further details we must refer our readers to Professor Theobald's work on the Geology of the Grisons (Graubünden), and to M. Desor's book just mentioned.

We thus seem to be making a little progress in theoretical knowledge, while in the department of actual acquaintance with the structure of the earth's crust much is being done. We find Geological Surveys at work almost everywhere in Christendom, even in most of our colonies; and through their labours we are obtaining a more extended knowledge of geological phenomena, though it must not be forgetten that much is due to exploring expeditions like that of the 'Novara.' It is our function to give in the GEOLOGICAL MAGAZINE the essential features of the results of these surveys; but we shall also endeavour to discuss with some freedom the more general questions suggested by them, for the future advance of Geology must chiefly depend upon successful investigations in distant and unexplored countries.

ORIGINAL ARTICLES.

I. OXFORD FOSSILS.—No. 1.

By Professor PHILLIPS, M.A., LL.D., F.R.S., &c.

[PLATE IX.]

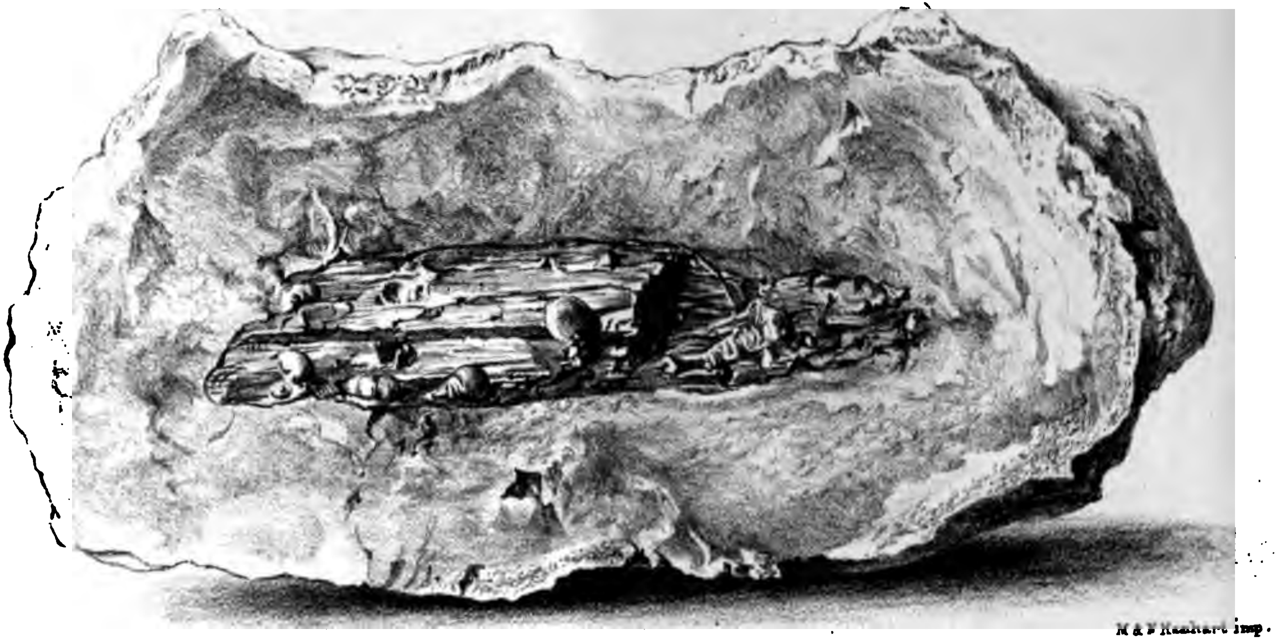
THE specimen of Fossil Wood in flint, figured in Pl. IX. of the GEOLOGICAL MAGAZINE, from a drawing by Mr. Crozier, was presented to the Oxford Museum by Sir Woodbine Parish, K.C.H., to whose intelligent liberality the public collections of England are greatly indebted. It was obtained from the Chalk of Winchester.

The nodule of flint which, when broken across, disclosed the included piece of wood, is of an elongated oval form, and with the uneven and knobbed surface which frequently indicates aggregation on a sponge. The fractured surface shows partial change of colour by watery actions from without, and many variations of tint within, arising from some original differences in the composition of the mass. The colour is on the whole lighter than is common in flints of the Upper Chalk. Examined with a lens, traces of spicula and other organic bodies appear, but it is not practicable to trace through the mass a distinct spongiose texture.

The wood lies in the middle, and the figure of the flint is in a general sense entirely conformed to it, and embraces it equally on all sides. There is a certain distinctness of tint in the flint where it is in contact with the wood. The wood is a fragment, worn and rounded in some of the prominent parts, and looks like a small portion of a pine-branch which had been exposed to rough treatment, so as to present a wasted surface deprived of the bark. It is entirely siliceous, and reveals in the utmost perfection the whole of the tissues.

Traversing the woody fibres are several short tubular masses, swollen at the end, and marked more or less plainly with transverse rings. These are flint moulds in cavities left by boring-shells, probably *Teredines*. It appears that these animals must have begun their operations in a young state on the wood when it had been reduced to its present figure and magnitude; for the moulds which remain in their holes appear to be quite small at the surface, and quickly to grow larger within.

Among the pleasures almost peculiar to geological study is the special gratification which many of the phenomena afford, even if we leave out of consideration the theoretical truths which the facts concur to establish. Every rock has its history; every pebble its vicissitudes; every fossil its accidents of life, and its casualties of death. In looking at this bit of wood in its flinty tomb, one easily imagines the train of probable events which led 'to this conclusion.' Far away from the Cretaceous Sea of Albion, among the mountains previously uplifted in the west, from which had flowed the great river of the Wealden, we see a forest of Coniferous trees.



T. Fielding lith

M & N Hanhart imp.

FOSSIL WOOD IN FLINT $\frac{2}{3}$ of nat size.

The original Specimen in the Oxford Museum.

remark of Mr. Plant's informer seems to me to prove. The author of the statement says the fragments, specially prepared with a coating of white-lime, were shaken in a basket of gravel, to give them the necessary red tinge. How this rubbing could be continued to the requisite length without removing the white-lime is doubtful. But after all, instead of having a red tinge, it so happens that these fossils have a peculiar and constant creamy-white colour. The redness is the fruit of the story-maker's own confusion between the 'gravel' according to the ordinary notions of gravel, and the gravel of the Macclesfield Drift-beds, which is a bright clean shingle.

That certain frauds have been more or less clumsily perpetrated, there is no doubt; but I repeat that they have not been such as to impose on a skilled and wary observer. They ought not, therefore, to be published without the definition of the true fossils, which, when shown to be reliable, constitute a material addition to the long and far-from-complete array of facts on which, sooner or later, a true theory of the Drift is to be founded.

Such frauds are, after all, not more than the ordinary fossil-buyer has been exposed to ever since and wherever there has been a market for specimens. The warning which Mr. Plant has repeated will save some unskilful collectors from loss and disgrace. It was never more needful than now-a-days, when so much is stated and published with an assumption of scientific acumen and authority which most seriously deranges the deliberate progress of true science.

Before I refer you to the specimens themselves, it is only fair to the officers of the Museum of Practical Geology in Jermyn Street, to point out that they were the first to indicate the fact of the supply of spurious specimens; and to the gentlemen who preside over the Museum of the Philosophical Society and the Free Museum in Liverpool, to state that neither of them have ever seen the Macclesfield fossils. We at Manchester have certainly not been deceived on the subject.

If I seem to have taken up too much of the time of the Society, it is because the rehabilitation of a damaged reputation is necessarily a matter which requires a certain elaborateness of detail. The effort is in the present case the more needful, as the most remarkable fact in connection with these Macclesfield fossils, is the occurrence amongst them of certain species of southern type; a circumstance so new to the phenomena of the Drift as to challenge the closest inquiry, even had there been no suggestion of fraudulent endeavour.

A very short inspection* of the specimens will probably satisfy those who see them side by side, that the Macclesfield series precisely correspond, as to their geological and zoological facies, with the Moel Tryfaen and Blackpool fossils, and may fairly rank with them.

For the sake of a more elaborate proof, and of a wider audience, I submit the following digested Table of all the specimens in question

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* Series of specimens are deposited in the Museums at Jermyn Street and Oxford.

	[illegible]	[illegible]	r.	[illegible]	[illegible] Some D.	fragments.		
	— rudis, *Donovan* . .	—	*v.r.*	—	1 broken shell. Others D.	*v.r.*	*r.*	
36	— litoralis, *Linn.*	—	*v.r.*	—	much-worn shells D. (No fragments seen.)	—	—	

(except only manifestly spurious ones), in comparison with similar specimens, as recorded from the Welsh and Lancashire localities. Every single specimen, or fragment of a specimen, in the Macclesfield series now exhibited, has been minutely compared, not only with specimens of known Drift-fossils, but with recent shells, and also with the results of an elaborate examination, which I have carried on, of the character and forms in which fragments of shells present themselves on the beaches and in the bed of the present British seas.

A few specimens whose authenticity is suspicious are marked in the 'Remarks' column with D. It is not impossible that they may yet prove to be genuine.

Almost all these remains are broken into small fragments, and are much rolled and worn. A certain number may be put on one side, as presenting an appearance of greater comparative freshness, having lost less animal matter. These uniformly show signs of great attrition. They are noted on the 4th column; the rest, noted in the 3rd column, look more completely mineralized, are often even friable, and all, except certain minute convolute shells, particularly broken up into small fragments. The latter series especially are almost always slightly adherent to the tongue.

While Mr. J. Gwyn Jeffreys' valuable Manual is still incomplete, I have thought it most convenient to use the nomenclature and arrangement of Messrs. Forbes and Hanley's 'British Mollusca.'

Scale of frequency:—*v. r.* very rare (1 to 3); *r* rare (3 to 6); *f.* frequent (about 12); *c.* common (twice or thrice as numerous); *a.* abundant.

III. A TOURIST'S NOTES ON THE SURFACE-GEOLOGY OF THE LAKE-DISTRICT.

By D. MACKINTOSH, F.G.S.

ALL geologists admit that the Lake-district of the North-west of England has been several times under the sea since the first upheaval of the alternating sedimentary and volcanic rocks of which it is composed; and few would be disposed to question that during the repeated processes of elevation and subsidence, whether continuous or intermittent, the sides of the mountains and valleys of this district have been long exposed, at different levels, to the action of waves, tides, and currents. We have reason to suppose that the duration of the last or intra-glacial submergence was at least as long as the time which has since elapsed; and if during the latter the sea has done so much to indent and modify our coasts, may we not expect to find the most obvious traces of its former denuding influence in regions which have risen above its level? Yet some of the pluvial, fluvial, and glacial geologists of the present day would soon reduce the sea to a subordinate rank in the list of causes, were it not for the masterly advocacy of marine denudation which, with fresh arguments, may be found in the successive editions of the works of Sir Charles Lyell and Sir R. I. Murchison.

Pluvial Action.—Origin of Rakes.—Before proceeding to the main subject of this article, it may be well to notice how far rains and rivers have modified the external configuration of the Lake-district. With regard to the first, I think it may be safely asserted that, unless under very peculiar circumstances, the effect of rain is limited to the removal of sand or mud, and the *roughening* of the surface of rocks, without any new or determinate shape being communicated, or the general outline altered. But this observation ceases to be applicable when mere pluvial action has passed into that of temporary brooks during heavy and continued falls of rain. These have evidently been instrumental to a considerable extent in clearing, deepening, and widening rents in the faces of cliffs, or sides of rocky declivities. What are locally called *rakes*, or narrow gulleys indenting precipices, and frequently ramifying or uniting, may be referred to original joints and vertical fractures in the rocks, afterwards enlarged by periodical torrents. But in many places the action of these torrents would appear to have been *supplemental* to ancient marine denudation; and the size of the delta of stones and gravel at the lower end of the rake will often approximately determine how much of the excavation is due to running water since the emergence of the land. In the case of some large rakes, moreover, blocks of rock have apparently been disentangled and carried down in a way which cannot be well explained without having recourse to oceanic agency; and when we consider that rakes are now forming on many sea-coasts, as well as enlarging in mountainous countries, the most philosophical explanation would perhaps refer the larger rakes of the Lake-district to the fundamental or *undermining* action of the sea, followed by the *degrading* action of pluvial torrents. Rakes largest at the top we might suppose to be mainly pluvial—those largest at the bottom marine. The gable-ends of several hills in Cumberland are deeply indented with rakes. Those on the Great End may be seen from a distance of many miles. But as the Great End presents the appearance of a denuded promontory, the rakes may have been mainly formed while the base of the cliff was still undermined by tides and currents. On the face of Goat Crag, behind Castle Crag (see accompanying cut), there are several picturesque rakes.*

Origin of Screes.—Screes are the loose materials which lie scattered between the crest of a declivity and the bottom of a valley. They are often the outwashings of rakes, but generally the irregular down-crumblings of precipices or slopes. They may be divided into two kinds, which graduate into each other—screes consisting chiefly of boulders, and screes composed of small fragments, sand, or mud. We can scarcely err in mainly attributing the latter accumulations to atmospheric action; but the detached blocks and large stones which are often seen scattered along the base of precipices, would seem to have been disentangled from their parent rock by a laterally rather than a vertically operating agency. In some instances, it is true, the place whence a block has recently fallen may be detected; but many of the blocks under consideration are either in positions (see accompanying woodcut), or exist in such numbers, as to call for an agency at once *undermining* and *dispersing*—in other words, the action of the sea; and this explanation would appear to be more especially necessary in the case of blocks considerably removed from their parent-cliff, imbedded in gravel, or forming part of an accumulation of stones which extend to a great depth (as often revealed by the passing stream) beneath the present surface of the lowest part of the valley.*

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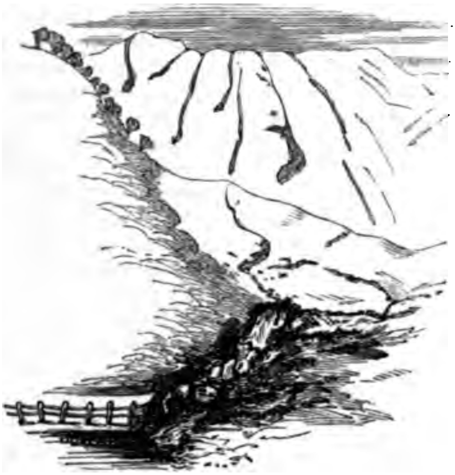
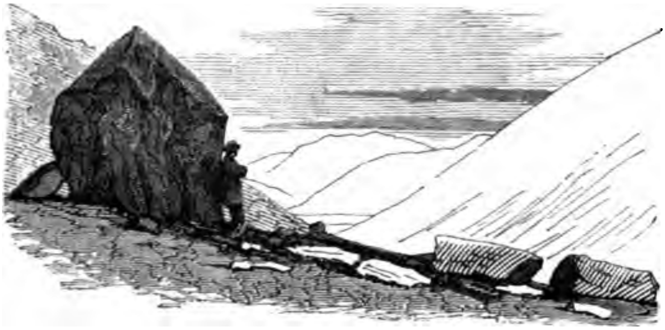
* Amongst the two largest rakes in Cumberland are Lady's Rake, in Wallow Crag, near Keswick, and Lord's Rake, on one side of Mickledoor Chasm, Scafell. The ascent of the latter is considered a great pedestrian feat.



View of Goat Crag, Cumberland.



Detached Blocks in Kirkstone Pass. (Trap-breccia and volcanic ash.)

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* For a notice of the occurrence of fossils in 'screes,' see Professor Harkness's paper *On the Skiddaw Slate Series*, Quart. Journ. Geol. Soc., vol. xix. pp. 113 *et seq.*

But the finest assemblage of huge blocks I have seen in the Lake-district occurs in an upland valley named Greenburn, very little visited by tourists, though perhaps surpassing every other in a certain kind of grandeur. This valley runs between Little Langdale and the hills called the Carrs. Its solitude has been only invaded by the not inappropriate copper-mine lately belonging to John Crossfield, Esq., of Ambleside. Between the copper-mine and the col under the Carrs, the back of the Wetherlamb Mountain is strewn with thousands of blocks, varying in size upwards to at least 30 or 40 feet in diameter. They present no indications of having been left by a descending glacier; but have evidently been disentangled from the rocky declivity above, and *irregularly* distributed. It would be going too far to assert that some of them may not have fallen since the last emergence of the land; but the sloping (not precipitous) rocky declivity above—the number and size of the fragments—the distances to which many of them have been carried into the valley—and many other considerations, forbid the idea of their being mainly due to any agency now operating on the spot; while the striking resemblance they present to sea-coast rocks justifies the conclusion that they were undermined, disentangled, scattered, and left in their present positions at the time when Greenburn Valley, along with the valley of Lever's Water, constituted a sea-strait, or after the strait was converted into two approximating creeks by the formation of the col which now separates the valleys. The precipitous and undermined appearance of the lofty towering cliffs on the right-hand side, and at the head of Greenburn, furnishes evidence of its being to a very great extent a valley of denudation.*

Ancient Straits and Creeks.—The only difference between many mountain-passes and a sea-strait consists in this, that the strait is still washed by the sea—the pass has long since been forsaken by the billows. One of the most striking instances of a forlorn strait, or rather group of straits, may be found in Borrowdale, more especially in the part still appropriately though unwittingly called the Straits of Borrowdale. Near the entrance, on the left, we have a *cwm* (see sequel) in which the sea has overdone its work; for the inner extremity of this cwm communicates by a very narrow strait with the larger Borrowdale strait. The latter is divided into two by the wood-crested rock called the Castle Crag. The Bowder Stone in Borrowdale has been regarded by guide-book writers as a block which has fallen from a neighbouring declivity; but I think that the associated phenomena rather indicate that it has been left by the sea—the softer parts or looser fragments having been washed away from the neighbourhood. Man has lately supplemented nature in clearing away fragments so as to render this celebrated stone a more conspicuous object.†

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* The most extensive screes in the Lake-district are on the south-east side of Wastwater, where nature is still very actively at work.

† A very obvious instance of an old sea-strait may be seen in the Mickledoor Chasm, which separates Scafell from Scafell Pike. This chasm, originally a gaping fracture, has evidently been enlarged by an oceanic current.

The terms ancient creeks, fiords, or voes (a name given to narrow inlets in Shetland) may be applied to most of the valleys of the Lake-district which are shut up at one end. When two valleys communicate by a col, they may have originated in a line of fracture; and Professor Harkness (see Quart. Journ. Geol. Soc., vol. xix. p. 128) regards Grisedale Valley, between Ullswater and Grasmere,[*] as running along an anticlinal axis. But many of the valleys in Westmoreland and Cumberland present indications of being almost exclusively due to the undermining and excavating agency of the sea. As may now be seen in Shetland, the sea would appear to have made a breach in a cliff or declivity in a particular direction, nothing further being necessary to enable it to pursue its work of voe-making. In some of the Lake-valleys, as in that which runs up from Kirkstone Foot in a direction parallel to Deepdale, the sea has left a number of blocks—some of them just detached from the parent rock, others carried to a short distance; as if, by a sudden rise of the land, it had been stopped short in its career, that it might leave monuments not only of its work of denudation, but of the various steps by which that work was accomplished.

Action of Rivers.—The streams which traverse most of the valleys of the Lake-district are too insignificant to justify the supposition that these valleys have been scooped out by running water since the last emergence of the land. In many valleys the level at which the action of the sea left off, and that of the stream commenced, can be traced in the abrupt commencement of the precipitous sides of the channel of the latter. A similar sudden break in the general slope of the sides of a valley, indicating the commencement of fluviatile as distinct from previous marine denudation, may be seen in Aber Valley, North Wales, and Ash's Valley, Longmynd, Shropshire. The latter furnishes a striking instance of a winding and bifurcating creek or voe. But in those river-gulleys which graduate upwards into larger valleys, we may often discover a sufficient distinction between their respective contours to justify our referring the one to fluviatile, and the other to marine denudation. Professor Sedgwick has noticed another kind of proof of the limited excavating power of rivers in the Lake-district, as being furnished by the small quantity of detritus they have yet been able to deposit in the lakes which receive their waters.[*]

Origin of Cwms.—The Welsh word *Cwm* is applied to a distinct class of hollows, which seem to point more strikingly than either passes or ordinary valleys to the sea as the *great excavator.* Few of these hollows correspond in shape with the lithological structure of the district in which they are situated: they are hollows of denudation *par excellence.* It is true that some of them, when viewed from a distance, appear as if an explosive force had suddenly blown up a part of the earth's crust. But this supposition would not be resorted to by an inductive geologist, more especially when he considers that cwms are not whole cups, but hollows with an entrance on one side. The innermost part of the semicircular cliff is generally the most precipitous, as one might expect, supposing the excavating cause to have operated in an inward direction. A good specimen of a cwm, containing a tarn, may be seen near the top of Saddleback: another occurs to the north of Whiteside, and north-west of Grisedale Pike; and its walls, which are very lofty, present an imposing appearance from the road leading along Whinlatter Pass.*

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[*] In connection with this subject, it is worthy of notice that there are many valleys and hollows of denudation in the Weald of Sussex with no streams flowing through them; while some of the valleys of Wiltshire and Dorsetshire present a series of raised beaches which embrace nearly the whole of the declivities on both sides, in such a way as to show that these valleys remain as they were left by the sea.

Ancient Sea-cliffs.—Wherever we meet with lines of precipices commencing suddenly, and (to a traveller approaching them from behind) unexpectedly, on the side of a mountain or in situations where no particular disruption has occurred, we are justified in regarding them as old sea-cliffs, more especially when they exhibit traces of having been undermined; for it is not so much by a disintegrating process that the sea encroaches on rocky coasts, as by undermining, displacing, and scattering fragments and blocks which have already been so far separated by joints and rents. Even in the case of cliffs originally formed by a great fracture, we can generally see indications of the subsequent action of the sea. In travelling in the Lake-district we continually meet with lines of precipitous escarpment running along one side of a mountain-range, the other side of which is a gradual slope. From an inspection of Howe's Model of the Lake-district at Bowness, and from subsequent observation, I was led to notice that the steep escarpments generally face the east, south-east, or north-east—apparently showing that the indenting and undermining current must have assailed the ancient Cumbrian Archipelago from the east. Among the numerous escarpments with an easterly aspect are the following:—A part of the western shore of Windermere Lake; the eastern side of the Old Man, and Wetherlamb Mountains; the eastern declivity of the Crinkle Crags; the precipice called Pavey Ark: the hills running along the western side of Grasmere Valley, the Gap of Dunmail, Thirlmere, and the road to Keswick; the eastern side of Helvellyn, which is not only the most precipitous, but indented with voes separated by edges, one of the voes terminating in Red Tarn Cwm; the western sides of Rydal and Scandale Valleys, near Ambleside; the eastern side of Kirkstone Fell, overhanging the pass; the western side of Kentmere Valley, &c. &c. In many of the narrow valleys, where the direction of the current would be deflected, we find precipitous escarpments on both sides, or sometimes on the exceptional side, as might be expected. In the western part of the Lake-district the steep escarpments exhibit no prevailing aspect; but this may be explained by supposing that the assumed current must have become very irregular, or in some places reversed, in the direction of its action, by the time it reached Borrowdale, Gatesgarth, or Wastdale.

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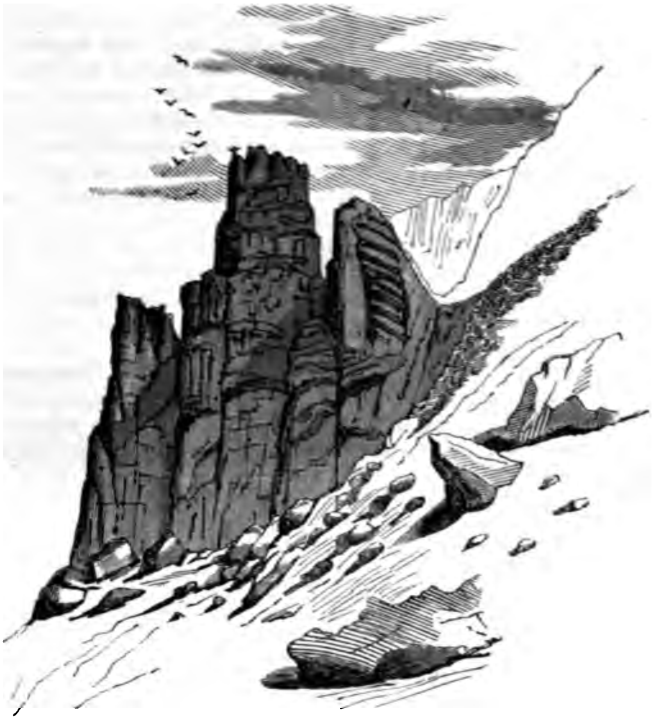
* Sir C. Lyell has marked an era in the history of geological discovery by his explanation of the denudation of the Weald of Sussex; but I am not aware that any geologist has yet taken notice of a *cwm* now in course of being excavated by the sea at Beachy Head.



The Pillar Rock, Ennerdale. (From a Sketch by Mr. Whitehead.)

The Pillar Rock.—As this apparently old sea-coast rock is scarcely noticed in guide-books, and its situation misstated in a costly work on the Lake-country lately published, perhaps some account of it may not be unacceptable to the readers of this Magazine. It is situated in Ennerdale, about two-thirds of the way up the side of the Pillar-mountain. Professor Sedgwick, many years ago, described the geological structure of Ennerdale, along with other parts of the Lake-district, with an accuracy which has bidden defiance to all attempts at revision or modification. Syenite may be seen at the base of the Pillar-mountain, and the rocks above have been so much altered by metamorphism, if not indeed originally volcanic, as to render it very puzzling to give a definite name to any particular specimen.* The crags on the side of this mountain have een ranked by Mr. Otley, the guide-book writer, as the first in the Lake-district. The great pile of rock called The Pillar presents a shape which can only be explained by denudation, and that chiefly a denudation by *fragmentary displacement*, which is the peculiar province of the sea. That this valley has been a creek, is evident from the number of undermined and denuded cliffs it contains, and especially from the terrace and accompanying line of cliff on the side of Revelin Pike. The geological tourist who, during the present summer, may wish to climb to the top of the Pillar Rock, will perhaps pardon me for digressing from the main subject, in conclusion, by giving a history of the very difficult and dangerous ascents which have already been achieved. This, after several months' inquiry, I was fortunate to procure from Mr. Whitehead, Infirmary Surgeon, Whitehaven.

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* In a kind note lately received from Professor Sedgwick, that venerable geologist, so far as he can now recollect, would call the Pillar Rock a mass of fine

On September 24, 1850, Mr. Whitehead ascended, and found two slips of paper, in a ginger-beer bottle, with the following inscriptions:—'Lieut. Wilson, R.N., Troutbeck, ascended the Pillar, May 6, 1848, and left this bottle as a memento of the same.—Charles A. C. Baumgartner. August 24, 1850. Cambridge.'

Mr. Whitehead afterwards ascended on May 24, 1853. The ginger-beer bottle left by Lieut. Wilson was still there, but the papers were gone, and in their place a nest of black beetles. These were dislodged, and in their place a piece of paper was put in the bottle with 'God save the Queen' written on it.

Charles William Hartley, a young man from Bradford, Yorkshire, ascended, Friday, May 24, and Monday, May 27, 1861.

Mr. Whitehead, a third time, ascended, Aug. 27, 1861, and found the paper left by Mr. Hartley.

So far on the undoubted authority of Mr. Whitehead. I have been informed that the Rev. Mr. Webster, late Curate of Keswick, has since ascended.

IV. MICROZOA OF THE VALLEY-DEPOSITS OF THE NAR, NORFOLK.

In the GEOLOGICAL MAGAZINE, No. VII., Mr. C. B. ROSE described the Brick-earth of the Nar Valley. To the list of Fossils which he gave at pp. 11 and 12, we can now add some minute but interesting forms, namely, four Bivalve Entomostraca and three Foraminifera. The former (all new species), determined by Mr. G. S. Brady, of Sunderland, are—

Cythere arborescens, *Brady*.
Cytheridea punctillata, *Brady*.
Normania carinata, *Brady*.
Cythere aspera, *Brady*.

In their general relationships, they are such as are found along the coast at the present day.

The Foraminifera have been determined by Mr. H. B. Brady, F.L.S., F.G.S., of Newcastle, whose note is as follows:—'Brick-

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porphyry, but would caution geologists against being deceived by the look of a fractured surface—the real structure of rocks of this class being best observed where the process of decomposition is going on.

earth of the Valley of the Nar, Norfolk. Specimen, No. 1.—Very muddy, grey clay, containing many molluscan shells (*Cerithium reticulatum*, &c.) and a few Otolites, in the small residue of the washing. This contains abundance of *Rotalia Beccarii* of all sizes, and also of *Nonionina striato-punctata*: the latter are small and delicate. No. 2.—Whitish, very shelly clay, leaving but little solid residue after washing. This is composed chiefly of broken fragments of Bivalves, and contains

Rotalia Beccarii; common.
Nonionina striato-punctata; common and small.
N. depressula; rare and small.

The whole of these Foraminifera are evidently from very shallow waters, possibly estuarine, or a few fathoms in depth, and resemble very closely some Oyster-ooze from the Firth of Forth.—T. R. J.

ABSTRACT OF FOREIGN MEMOIR.

The Triassic Rocks of California.

FROM an interesting communication to the 'American Journal of Science,'* by Professor Whitney, on the progress of the Geological Survey of California, it appears that one of the most striking results of the Survey is the proof of an immense development, on the Pacific side of North America, of rocks equivalent in age to the Upper Trias of the Alps, and palæontologically closely allied to the Limestones of Hallstadt and Aussee, and the St. Cassian beds of the Alpine Trias. This Triassic belt of the Pacific Coast has been explored in the latitude of 40°, and east and west from 117 to 121 degrees of longitude; and from this region the largest portion of the fossils have been obtained, both from the three parallel ranges called the Humboldt Ranges, and from Plumas County, California. This formation extends from Mexico to British Columbia, occupying a vast area, although much broken up, interrupted, and covered by volcanic and eruptive rocks, and usually highly metamorphosed. Among the specimens collected, four species have been recognised by Mr. Gabb as identical with European forms; whilst the whole *facies* resembles that of the Hallstadt beds—the same intermixture of *Orthocerata*, *Ceratites*, *Goniatites*, *Nautili*, and *Ammonites*; together with *Halobia*, *Monotis*, *Avicula*, *Pecten*, &c.; a *Monotis* being the most widely diffused and abundant of all.

Accompanying this Triassic formation in the Sierra Nevada, is an extensive development of Jurassic rocks, usually highly metamorphosed and extremely barren of fossils. The sedimentary portion of the great metalliferous belt of the Pacific Coast of North America is chiefly made up of rocks of Jurassic and Triassic age, with comparatively little of the Carboniferous Limestone. While, therefore, *a large portion of the auriferous rocks of California consist of Metamorphic, Triassic, and Jurassic strata*, there is no evidence

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* See Geological Magazine, No. 11, Vol. II., for May 1865.

(says Prof. Whitney) to uphold the theory that has been so often maintained, that all, or even a portion, of the Auriferous Slates are older than the Carboniferous; not a trace of a Devonian or Silurian fossil ever having been discovered in California. Indeed, gold, instead of being chiefly limited to Silurian rocks, occurs in no inconsiderable quantity in Metamorphic rocks belonging as high up in the series as the Cretaceous group (see also p. 330). With regard to the detrital auriferous deposits, they consist of materials brought down from mountain-heights above, and deposited in pre-existing valleys; beds of ancient rivers, and in lake-like expansions of former watercourses, during the later Pliocene epoch, and not at the Drift or Diluvial period, as is proved by the remains of the plants and animals imbedded in them. These auriferous deposits were succeeded throughout the whole extent of the Sierra Nevada by heavy accumulations of volcanic sediments, ashes, pumice, and finally by a general outpouring of lava, covering and concealing under hundreds of feet in thickness the auriferous gravels.

[The Hallstadt beds alluded to above, forming a subdivision of the South European Triassic group, are well developed in the Eastern Alps, and contain extensive beds of Rock-salt at Aussee, Hallstadt, Hallein, and elsewhere, which, wrought either by mining or by artificial brine-works,* yield an important item (about £7,000,000) to the Austrian Government. The fossiliferous limestone, lying above the salt-works at Hallstadt, is worked for marble, and has yielded a large series of characteristic fossils to the care and labour of M. Ramsauer, who has been also successful in his archæological researches in this district, and has discovered in the old cellarium of the salt-mines, the bronze pickaxes of the ancient people who worked the salt, it appears, about four centuries B.C.]—J. M.

REVIEWS.

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LE DARWINISME: OU, EXAMEN DE LA THÉORIE RELATIVE À L'ORIGINE DES ESPÈCES. Par A. L. A. FÉE. Paris, 1864.

DARWINISM, as the Theory of the Origin of Species by Natural Selection is sometimes, especially by theological adversaries, absurdly called, has in this author no very formidable opponent. M. Fée admits certain modifications of animal and vegetable forms, but recognizes no other influence in their production than that of a Final Cause. The extinction of certain anomalous forms is ascribed to the fact that Nature's ill-directed efforts having failed to adapt their organization to the circumstances under which they were placed, they have gradually succumbed to the destructive agencies by which they were surrounded, and have been removed from the earth by a natural process, not of selection, but 'depuration.' The author's right to pronounce upon the physiological questions involved in the views he criticises may be inferred from his seriously urging as an objection to the Divergence of Character, that the universal germ, to which he traces back Darwin's progenitors of the animal and vegetable series, must have contained all subsequent forms, since they would all, despite their differences of form and capabilities, have been derived from it; just as the germ of the individual contains only one embryo. Such a statement of abandoned Evolution Notions was scarcely to be anticipated in a member of the Medical Faculty of Strasburg. In any criticism of Darwin's work, the evidence derived from geology ought to hold a prominent place; but our author hesitatingly admits, if he does admit, the non-universality of the Deluge,—sees in the sharply separated faunas of the older rocks proof of the plurality of original forms,—and rests the immutability of species on their permanence since 'diluvial' times, whatever they are.

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* Water, poured in from above, and left awhile to dissolve the salt, is recovered by pumping, and evaporated, after being led to a distance of many miles.

It is not, however, to the physiological and geological inaccuracies of M. Fée that we would now direct attention, but to the serious error of representing Mr. Darwin's views as pointing to a progression of which 'perfection' is the goal. He imagines that the perfection to which, according to the views he opposes (not Darwin's), organic forms are tending, is an ideal standard of beauty; and naturally asks, where is this standard to be found? These notions are expanded in several rhetorical passages, neat in structure, but obscured by the loose way in which scientific terms are employed. Now, in the first place, Mr. Darwin is, for the reasons acutely pointed out by Sir C. Lyell in his 'Antiquity of Man,' very cautious in his support of any theory of progression. The most eloquent passages in his work are those in which he urges the fragmentary character of the geological record, on the assumed completeness of which alone could any scheme of progression be founded. And in the second place, by Perfection no more is meant than an ever-increasing accuracy of relation between the Organism and the Conditions under which it is placed. With Human Progression in a moral sense, no morphological theories have anything to do: it is only with Man as an animal, and his relations as such to other animals and to the inorganic world, that Zoology is concerned. To speak, therefore, of a period when æsthetics shall so far prevail in the world that even the rose will lose its spines, and to suggest such millennial fancies as in any way flowing from the Darwinian Theory, is grossly to misrepresent that theory, and to wander far from the true scope of scientific enquiry.

Another error of nearly equal magnitude is to represent time as the only element of change. It is only one factor; the other is varying conditions, meaning by that phrase not merely climatal vicissitudes, and those less appreciable causes, loosely included under climate, which affect the spread of organisms even over districts contiguous to those whence they started,—but also competition, whether caused by quest of food, or by that desire of superiority, common, as John Hunter long ago pointed out, to all animals, alike to those which devour flesh and those which do not. Of the animals exposed to these hostile influences, only a certain proportion survive;

and those which do so are by the theory supposed to possess some slight modification of structure or endowment giving them a superiority over their less favoured brethren who have failed in the struggle. The transmission, by the survivors, of the slight modification to which they owe their continued existence, together with the other characters of the species, is all that is claimed by the Theory. The modification is 'accidental,' not by hazard, but as the result of some slight, unknown cause operating on the variability of the species. It is this unconsciousness of the change which distinguishes Darwin's Theory from that of Lamarck, who ascribed to the animal an active share, through volition, in inducing the modification.

In showing that Darwinism is not original, M. Fée has not clearly stated the difference between this and preceding theories; he has further adopted an unsound criticism against which we would protest as one frequently ungenerous in its results. He finds in Restif de la Bretonne, 1781, an anticipation of the doctrines of 1859. On his own showing, this anticipation amounts only to a belief in a single progenitor in the animal and vegetable kingdoms respectively, whose descendants have differed under the influences of soil and temperature. But this belief was, by his own confession, 'hatched in a head purely literary,' by one 'who only wanted a little more reason to become a man of great eminence.' To dignify such random statements by the name of a system, and to regard them as anticipations of views which were only acquired by long careful and extended observation, and were beyond the reach of intuition (the very science, Geology, which alone gave them substance, being of subsequent birth), is an easy weapon of depreciation, but is alike unjust to the merits of the earlier and later thinker.

MEMOIRS OF THE GEOLOGICAL SURVEY OF INDIA, VOL. III. PART 2. 'ON THE GEOLOGICAL STRUCTURE AND RELATIONS OF THE SOUTHERN PORTION OF THE HIMALAYAN RANGES, BETWEEN THE RIVERS GANGES AND RAVEE.' By H. B. MEDLICOTT, B.A., F.G.S., of the Geological Survey of India. 8vo. 1864.

THIS Memoir is of interest, not only to Indian geologists, from its adding to their knowledge of the geological structure of an important part of their adopted country, but also to those who have no personal knowledge of India, from the author's remarks on the general structure of hills (not only in the chapter on that subject, but broadly scattered throughout), and his Appendix on the various theories of the formation of mountains. It treats of an area of about 7,000 square miles, containing some of the oldest of the 'hill-stations,' and belonging to the 'Eastern Himalaya;' a tract which consists of 'three well-marked regions:—the range of peaks; then a broad band of hills, commonly spoken of as the Lower or Outer Himalaya; and outside (south) . . . a narrow fringing band of much lower hills (Sub-Himalaya), . . . of which the Sivâlik hills are the type.' The second of these well shows the denudation-type of hill, having irregular ridges and river-courses 'transverse to the general direction of the mountain-region;' so much so, indeed, that the author could not 'trace even the guiding influence of simple fissures, in any definite system, in predetermining the lines of drainage.' Though the hills are sometimes 10,000 or 12,000 feet high, yet there is mostly great sameness in their scenery,—'a monotony of steep slopes, and ridges of uniform height, and with little variety of outline.' Their outer limit is for the most part well marked by a quick change to much lower hills of different aspect. The ridges of this third region 'are approximately coincident with lines of disturbance, being usually formed by anticlinals, or on the upthrow side of faults;' though, of course, Mr. Medlicott does not by any means imply that these Sub-Himalayan hills have been formed by disturbance only, as further on he says, 'No doubt, the actual contours in both cases are the immediate results of denudation.' Such being the case, we do not see why the Sub-Himalayan hills should be called 'true hill-ranges,—members proper . . . of the great Himalayan, system,' whilst, by implication, those of the Lower Himalaya are not. The latter are the higher and the nearer to the region of peaks; the mere fact that they have been carved out without any particular regard to lines of disturbance does not surely go against their being 'true hill-ranges'!—if so, half the mountains in the world can hardly lay claim to the title. We suspect that Mr. Medlicott draws some subtle distinction between a 'hill-range' and a 'range of hills,' and somewhat confuses the former with a 'line of elevation.' Those hills that have been worn out across, and in defiance of, disturbances are rather more marvellous than those in which the denudation-surface more or less follows the geological outline. These regions, however, are not marked by differences of feature only, but consist of 'two series of rocks strongly contrasting in composition.' As these are in vertical contact along their well-marked boundary, it would have been a difficult matter to tell which was the older, were there not a very large outlier of the Sub-Himalayan beds resting 'on a denuded surface of the older rocks.'

With the remark, that 'there is perhaps now an over-tendency to allow fossil evidence too exclusively to regulate our classification of rock-series,' we heartily agree; but it is no reason that Mr. Medlicott should not have vouchsafed us a little more information about the fossils of these vast sets of beds than is given by one list, and here and there a few chance words, such as—although the 'central region of our district . . . is the classic ground of the Fauna Sivâlensis;'—'These giant fossils' (what they are we are not told) 'are found through some thousands of feet in thickness of the Sivâlik rocks,' the uppermost member of the Sub-Himalayan Series: but Mr. Medlicott was unable 'to trace one single fossil to the Nahun beds' below, though he states that some letters of Col. Cautley and Dr. Falconer seem to point to fossils having been found in the latter.

From the list of formations given at p. 17, we learn that the beds of the district consist, in descending order, of the 'Sub-Himalayan Series,' divided into the 'Sivâlik,' 'Nahun,' and 'Subathu' groups; and the 'Himalayan Series,' of 'Unmetamorphic' (four divisions) and 'Metamorphic' rocks. This, however, is not a perfect list; for at

p. 152 we find an account of some 'Post-Sivâlik' beds, and at p. 56
suggestion of there being some 'Supra-Krol' rocks (top of the Hima
layan). What the age of these formations may be is not stated in th
list, though elsewhere we gather that the Sub-Himalayan Series, th
connection of the groups of which is based 'on purely lithological an
structural considerations,' is of Tertiary age; but as to the Hima
layan Series, one's imagination is left to roam from Tertiary down t
Laurentian for nearly fifty pages, when we find that it may still roa
within the same limits, as nothing is known of the age of that serie
By the way, it is like an Irish bull to give the name 'Sub-Himalaya
to a set of beds which lie *above* those called 'Himalayan;' althoug
the hills of the former are lower (or under) those of the latter, an
therefore the name is geographically right.

At p. 19, there are some very interesting remarks on the connectic
between the disturbed and tilted Sivâlik rocks, and the undisturbe
'deposits of the plains.' The upper beds of the former are of th
same composition as the latter, which 'overlap the deunded base o
the Sivâlik hills, just as the Sivâlik rocks overlap the denuded ba
of the Nahun hills:' the relation of the Gangetic to the Sivâlik bed
Mr. Medlicott thinks, therefore, to be the same as that of the latt
to the Nahun beds. This connection between past and present co
ditions is further marked by the 'coincidence between the vari
tions of the Sivâlik deposits and the actual positions of the grea
river-courses, . . . thus proving the great antiquity of even th
details of the actual configuration;' a view which the author was th
more ready to take from seeing 'the prodigious results of atmospher
denudation in excavating the deep winding valleys through th
mountains.' The coarse boulder-beds of Sivâlik age have bee
greatly disturbed, 'often deeply faulted, sharply folded, vertical, ar
even inverted: yet all this has been effected without sensibly affectin
the details of contour in the adjoining mountain-region.'

Having given a general description of the district and its rock
the author goes on to describe the latter in greater detail, beginnin
with the oldest series, but with the newest group of that series, th
is, in a sort of half-descending, half-ascending order. Here, howeve
we need not follow him so closely, as the subject is almost whol
Indian, but will pick out those parts that have a wider interes
noting first that there is an 'almost total absence of fossils in all th
rocks of the Lower Himalaya,' and that but one undoubtedly intrusi
rock, a trap, has been found in the large tract of country described

In the way he treats some of the commonest geological terms, M
Medlicott is again true to his nationality; and after saying that
'must anticipate any ambiguity that might arise from the uncerta
meaning of some common rock-names,' he at once throws us into
state of utter bewilderment as to the meaning of 'slate' and 'gri
He objects to 'slate' being used only for rocks showing cleavage
some perfection, and says that 'such is not its general use amo
English writers' (!)—from which remark we must totally disagre
Again, he uses 'grit' for rocks 'too fine-grained and earthy to b
called sandstone, and too rough for a slate,' and thinks that in

doing he is 'accepting the practice of English field-geologists'! He believes that 'the usual glossary-meaning of the word is a sharp sandstone, coarse or fine:' we have always thought that a grit was simply a very coarse sandstone, or in other words something between a sandstone and a conglomerate. To know what a 'slate-grit' may be, in this Memoir, needs a special revelation from the author, who, we hope, in his next will either use such common words in their well-known and accepted sense, or will favour his readers with a glossary of his own peculiar dialect. In applying 'schist' to foliated rocks only, he does, however, agree with English geologists.

In the outer zones of the Lower Himalayas, the ridges are along synclinals, and in some hills there is even a 'quâquâversal convergence of dips,' the result of which is to form, with the help of denudation, a deep crater-like hollow at the top. We would remark that this inwards dip is the one most likely to save the beds from denudation, as there is no tendency for masses to slip off in any direction; but, on the other hand, they tend to slide inwards along the lines of bedding. Mr. Ruskin has drawn attention to this and other like matters in vol. iv. of 'Modern Painters.' At p. 34, Mr. Medlicott notices that at Simla the upper rocks have been more altered than the lower, and also 'show much more local crushing and contortion.' This phenomenon in metamorphism is not, of course, noted here for the first time, as it has been proved that in the Scotch Highlands a Lower Silurian quartzite overlies unaltered red conglomerates of Cambrian age. At p. 72 we have a slight disagreement with the brothers Schlagintweit: what they took for cleavage, Mr. Medlicott says is a very good example of bedding; and he states that he could see no general system of cleavage in the district.

The lower set of rocks being dismissed, the Sub-Himalayan Series, the special object of the Memoir, is described. Of these, the lowest group, the Subathu beds, we are told (pp. 74–6) are of Nummulitic age, and of varied mineral character; they 'rest upon a deeply denuded surface of the Lower Himalayan rocks;' their 'present boundary' seems to have been nearly their 'original limit of deposition;' and the lower rocks 'had undergone comparatively little disturbance' before their deposition. This last, however, seems to us hardly to agree with the deep denudation of the older rocks before the deposition of the newer on them: and the author, indeed, qualifies the statement at p. 86, where he states that the denudation implies disturbance, but he thinks that it was not of that sort which causes contortion or bending, and that this pre-nummulitic elevation took place on the same lines as those that now mark the Himalayan system, which therefore would not result from one upheaval, after the deposition of the Sub-Himalayan beds. Mr. Medlicott is of opinion that 'the Nummulitic Limestone of the Salt-range is the open-sea contemporary of the Subathu group,' though none of the fossils yet known are common to both groups. The junction of the Subathu beds with the overlying Nahun beds looks like an immense fault: there are no outliers of the latter on the former, and no inliers of the former within the area of the latter. The author thinks that the boundary is really a coast-line (which may perhaps have afterwards suffered from shifting), its irregular course being against the idea of an origin by a fault. The account of these beds is closed with a note of the fossils found in them, amongst which are many Plants, 'probably of Middle Tertiary age.' It is a strange thing, that whenever plants are found in Tertiary beds, they are nearly always said to be 'Miocene' or 'Middle Tertiary.'

The Nahun beds, our author says, consist in great part of a sharp soft sandstone, here and there with clays and iron-ore, and at one place conglomerate. It is often hard to divide these from the overlying beds.

The Sivâlik group, where most developed, may be subdivided into four; the lowest having more or less clay with the sandstone of which this group, as that below, mainly consists; the next is almost wholly sandstone, passing upwards into the third, which is conglomeratic; whilst the fourth is made up of clays and conglomerates: at one spot the middle two are together 15,000 feet thick. As 'no two sections . . . . of these rocks are exactly alike,' the geology of the Sivâliks can be no easy task to work out. We have before noticed that these beds are said by Mr. Medlicott to be in some measure related to the present system of valleys; and in proof of this he remarks, 'the greater accumulation of boulder-deposits (in this group) in the immediate regions of the great rivers is very noticeable.' At p. 122, we are told that at the great river-gorges there are transverse fractures; but our author does not accept the usual explanation of the waters having naturally selected these as weaker parts wherein to cut a channel, thinking that to do so may be 'putting the cart before the horse,' and suggesting, on the other hand, 'whether the rivers, for the existence of which in this position during the Sivâlik period we have such good evidence, may not have been the predetermining cause of these transverse fissures.'

In a short account of the Post-Sivâlik beds, the author states his belief that the deep valleys and gorges have been formed 'by river-action and atmospheric denudation generally,' rather than by marine denudation, as has been supposed.

In India, as elsewhere, rivers often go out of their way to cut a channel through hard rocks when a nearer course seems to have been open to them through softer beds, which 'may safely lead us to infer very remote conditions of the surface, very different from what is now apparent.' With regard to the general structure of the hills, the author thinks that the disturbances in the Sub-Himalayan rocks 'have no direct connection with the formation of the mountains;' but that they have been caused by 'the thrust from the mountain-mass consequent on the sinking of that mass:' the disturbance of the older rocks, however, he thinks to have been caused by elevation.

The last chapter is on Economic Geology, of which there is not much to be said, as it would be 'difficult to find elsewhere an equal area of mountain-country so barren of mineral wealth.' Building-stones and slate are to be got in places; gypsum, salt, iron, copper, and lead are worked; and gold is found in the beds of rivers, 'even in streams which only drain the Sub-Himalayan rocks,' so that it must have 'a doubly derivative origin,' because, so far as known, it never occurs in veins in any but very old rocks.

The Memoir ends with an Appendix on Theories of Mountain-formation, in which an account is given of the views that have been put forward by men of note. First, however, the author draws a distinction between physical geography and physical geology different from that which is usually held. He would use the former with regard to the present 'aspects of nature' and 'the form and position of mountains,' whilst he looks upon the latter as relating to 'past activities,' its object being 'to investigate the mode of origin of mountains.' This seems to be using the term physical geology for a very theoretical matter.

The chief theories of mountain-formation are:—(1) E. de Beaumont's, according to which the contraction, by cooling, of the supposed fluid internal mass of the earth has been the cause of the distortion and fracture of the comparatively thin crust. The best-known part of this theory is the doctrine that parallel mountain-chains are of the same age as regards elevation, and that successive convulsions would have their directions in pentagonal symmetry. We cannot agree with Mr. Medlicott in being captivated by its grandeur, and giving way to a hope that it may turn out right in the main; for, as he says, it is 'far beyond our actual knowledge of geology,' and therefore has really little to stand on: indeed, we think that Mr. Hopkins* has clearly shown its great weakness and inconsistency with known facts.—(2) Mr. Hopkins supposes elevations to be caused by the expansion of fluids or gases in vast hollows in the earth's crust, and he seems to think that elevations are far more local than is supposed by de Beaumont. The result of elevation would be to produce longitudinal and transverse fissures, the former with 'a parallelism to the geometrical axis of the area' acted on, and the latter at right angles to these. This theory is applied by its author to the Weald; but we fear that, when the detailed geological examination of that district has been finished, many of the lines of disturbance laid down by Mr. Hopkins will be found somewhat imaginary; though, should this be the case, we agree with Mr. Medlicott that 'his paper will retain its value as a discussion of one set of conditions.'—(3) Prof. H. D. Rogers thinks that the undulations of the crust of the earth could have been caused neither by simple upward nor lateral pressure; but that they are owing to a wave-like motion on the surface of the molten fluid beneath.—(4) The theory of Babbage and Herschel rests on the fact that the contour of underground isothermal lines depends on that of the surface. If the surface is changed, therefore, by deposition or denudation, these isothermal lines will change also, and an expansion or contraction of the rocks will take place, giving rise to disturbance. We would ask, however, how the deposition and denudation, to the great extent needed, are to take place without elevation and subsidence of the ground beforehand?

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* Presidential Address to Geol. Soc. 1853.

A theory has been lately put forward by Prof. Bischoff, too late for notice in this Memoir, that elevation and depression 'have resulted from an increase or decrease of volume in deeply seated rocks, in consequence of the more or less complete displacement of the silica of their silicates by carbonic acid.'*

We cannot forbear quoting a passage from the close of this Appendix:—'A study of the existing state of any portion of the earth's surface will show that denudation is, in fact, more a hill-maker than a hill-destroyer. . . . In what I say here, I, of course, allude to subaërial, pluvial denudation, by rain and rivers. Oceanic denudation may perform a greater amount of work in abrading and transporting matter; . . . but, as a rule, and as compared with pluvial denudation, it is purely a levelling agent; it carries away wholesale where the other agency would work out mountain-systems on its own principles.' The relation of the two kinds of denudation has been ably worked out by Prof. Ramsay for the district of the Weald.†

It is not a little strange that the advocates of theories of atmospheric denudation should be chiefly found, of late days, in the ranks of our Geological Surveys,—Ramsay, Jukes, and Logan being followed by Medlicott, Geikie, and others; and we think it not a small thing in favour of these views, that they are upheld by those who, of all men, should know something of that 'form of the ground' by the careful and detailed examination of which they get their living. To Hutton, Playfair, and Scrope belongs the honour of being the earlier advocates.

With the Memoir is a map, on a scale of eight miles to an inch; and there are also three lithographic plates, as indistinct as is usual with that style of illustration, and many woodcut sections. The 'get up' contrasts very favourably with the thin paper and crowded type of our own Geological Survey Memoirs, which, we feel assured, would be thought more of were they printed as they should be, and not sacrificed to a miserable and mistaken notion of Governmental economy.

To conclude, the work, which is a credit both to its author and to the Geological Survey of India, should be read by every philosophical geologist.

ON THE FORMATION AND HISTORY OF THE MALVERN HILLS. By Dr. H. B. HOLL, F.G.S. [Quart. Journ. Geol. Soc., No. 81, February, 1865.]

THE principal object of this valuable paper is to show that the rocks which constitute the axis of the Malvern Range, and which have hitherto been treated of as syenite, &c., are in reality of *Metamorphic* origin, and consist of a variety of gneissic and schistose rocks, partly micaceous, but chiefly hornblendic, with occasional sub-crystalline bands, and beds of coarse-grained diorite interstratified; traversed also abundantly by quartzo-felspathic veins, and invaded by dykes and masses of erupted trap (diabase): and Dr. Holl has endeavoured to prove that they form a part of the old Pre-Cambrian continents, of which the metamorphic rocks of British North America, of Scandinavia, Bohemia, Brittany, and the Channel Islands—of the Lewis, the Malverns, Charnwood Forest, Donegal, &c., are uncovered areas, forming what Professor Dana has called a 'Universal Formation,' on which all the other stratified deposits repose.

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* Quarterly Journal of Science, vol. i. p. 475 (June 1864).

† The Physical Geology and Geography of Great Britain, 2nd edit., 1864.

The presumed great antiquity of the Malvern metamorphic rocks rests upon a variety of evidence. The fact that rocks of Upper Cambrian age rest directly on the flanks of the range shows that the crystalline rocks are by position at least as old as the Lower Cambrian system. But the author has also shown that the Malvern Range was, if not dry land, at least a submarine ridge at the period of the deposition of these Upper Cambrian beds, by the shallow-water conditions they present, and by the fragments of the crystalline rocks of the hills they contain; and that they were laid down on the upturned edges of the metamorphic rocks: and further, that from the oblique direction of the strike of the metamorphic rocks (NW. and SE.) and from other evidence, it is clear that the portion uncovered along the Range of the Malverns is only part of a much larger area. The metamorphism of extensive areas, however, can be due only to some general cause. The production of these changes, therefore, in the Malvern rocks, their subsequent invasion by granitic veins and trap-dykes, and their upheaval and tilting into highly inclined positions, must have occupied an enormous period of time, which could not have been more recent than the Lower Cambrian epoch; and the period of their accumulation (there is a vast thickness of these metamorphic rocks) must have preceded this. The conclusion, therefore, appears a fair one that these rocks must be of Pre-Cambrian age, and their chemical constitution supports this view, inasmuch as, like the rocks of Canada, the Hebrides, Scandinavia, Donegal, &c., which are admitted to be of Laurentian age, they contain an abundance of basic minerals, such as hornblende, epidote, ferro-aluminous mica, &c., and felspars poor in silica.

Dr. Holl then goes on to show the dynamical changes that the range has undergone:—first, that it was probably dry land (or at least high ground) in the Primordial sea, and that it was subsiding during the deposition of the Upper Cambrian series;—that it was again dry land, and had been subjected to denudation, at the period of the deposition of the May Hill Sandstone, as shown by the shallow-water conditions, and successive overlap of the beds; and that the subsidence which accompanied their deposition was continued through the whole of the Upper Silurian period until the close of the Lower Old Red, but that elevation then again took place, as seen by the absence of the Middle Devonian beds, and by the attenuation, in the direction of the Malverns, of the Upper Old Red, the Carboniferous Limestone, and Millstone-grit; the thin deposits of Coal to the North and South of the Range having been laid down unconformably on the denuded surface of the Lower Old Red and Upper Silurian rocks: also that oscillations of level took place during the Permian and Triassic periods, as shown by the unconformities between the several members of these groups; and that the last great catastrophe, which brought down the Trias on the Eastern side of the Range, was posterior in date to the Lias.

REPORTS AND PROCEEDINGS.

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Geological Society of London.—June 7, 1865; W. J. Hamilton, Esq., President, in the chair. The following communications were read:—

1. 'Note on *Ovibos moschatus*, Blainville.' By M. E. Lartêt, For. Mem. G. S. Translated by the late H. Christy, Esq., F.R.S., F.G.S.—A hoof-phalange found by Mr. Christy and the author in the Gorge d'Enfer was stated to be identical in form and dimensions with the corresponding bone of the existing *Ovibos moschatus*, to which species M. Lartêt therefore referred it. With it were found remains of *Ursus spelæus*, *Felis spelæa*, Wolf, Reindeer, and Aurochs, as well as worked flints differing from those found in any other of the Dordogne caves. The author remarked that the Gorge d'Enfer is the most southern locality at which remains of *Ovibos moschatus* have yet been found, and is 15° south of its most southern limit at the present day; but the Reindeer has been found by Mr. Christy and himself farther south still—on the northern slope of the Pyrenees.

2. 'On some Additional Fossils from the Lingula-flags.' By J. W. Salter, Esq., F.G.S. With a Note on the Genus *Anopolenus*; by Henry Hicks, Esq., M.R.C.S.—In a recent paper Mr. Salter described the new genus *Anopolenus* as a blind Trilobite allied to *Paradoxides*, without facial sutures or head-spines, and with truncate body-segments not produced into spinous appendages, as in most of its congeners. The remains of a new species, provided with extraordinary free cheeks, have proved that this conclusion was founded upon a part only of the head and of the body of the animal, which now appears to be more truly intermediate between *Paradoxides* and *Olenus* than was before supposed, while at the same time it presents characters opposed to those of either genus. Mr. Hicks gave a full description of the genus as now known, and of the new species, which he called *Anopolenus Salteri.* From his description, it appears that *Anopolenus* possessed minute eyes, a facial suture, and expanded pleura, but that their arrangement was abnormal. In conclusion, Mr. Salter compared the two species of *Anopolenus* now known, stating that the one first described, without the more anterior of the two segments which compose the head, was to all appearance a perfect Trilobite. He also gave a figure of a new species of *Olenus* —*O. pecten.*

3. 'On the Discovery of a New Genus of *Cirripedia* in the "Wenlock Shale of Dudley."' By Henry Woodward, Esq., F.G.S. —The attention of the author having been called to two species of

Chiton described by M. de Koninck from the Wenlock Shale, he found one of them (*Chiton Wrightianus*) to be a Cirripede. He stated that the distinctive characters of Chiton are—(1) The valves never exceed eight in number; (2) the series is always unilinear; (3) the valves are always symmetrical, and divided into three areas. The species mentioned does not, however, conform to any of these characters, as it had probably as many as four rows of unsymmetrical plates, having no apophyses, a uniformly sculptured surface, and not divided into three areas: each series exceeded eight in number. Mr. Woodward then showed that *Chiton Wrightianus* was really a Cirripede, and formed the type of a new genus, to which he gave the name *Turrilepas Wrightii*.

4. 'On some New Species of *Eurypterida*.' By Henry Woodward, Esq., F.G.S.—In his 'Advanced Text-book of Geology,' Mr. Page figured and named the only known species (*S. Powriei*) of his new genus *Stylonurus*, but gave no description of it. Mr. Woodward now described the species in detail, from specimens found near Pitscandly, in the Turin Hill Range, Forfarshire; he also gave a description of a new species (*S. Scoticus*) found in an Old Red Sandstone quarry in Montroman Muir, near the Forfar and Montrose Pike. Mr. Salter has expressed an opinion that *S. Powriei* is a full-grown male, and *S. Scoticus* a young female of the same species; but Mr. Woodward observed that if the sexes are not to be determined by the thoracic plates, but by more general characters, then the two forms of plates in *Slimonia* indicate two species of females, and the two forms in *Pterygotus minor* ought to indicate two species of males.

5. 'On a New Genus of *Eurypterida* from the Lower Ludlow Rocks of Leintwardine, Shropshire.' By Henry Woodward, Esq., F.G.S. —In this paper Mr. Woodward described a Crustacean alluded to by Mr. Salter in the 'Annals and Magazine of Natural History' for 1857, under the MS. name of *Limuloides*. It appears to form a connecting link between the *Xiphosura* and the *Eurypterida*, but it differs from the former in not having a cephalothorax—the cephalic, thoracic, and abdominal divisions being distinct, and apparently capable of separate flexure—and from the latter in having only three thoracic segments. The name *Limuloides* not being allowable as a generic appellation, the author applied it to the most perfect example of the genus, using the generic term *Hemiaspis*.

The following specimens were exhibited:—Toe-bone of *Ovibos moschatus*, from the Gorge d'Enfer; presented by the late H. Christy, Esq., F.G.S.

Turrilepas (*Chiton*) *Wrightii*, from the Wenlock Shale, Dudley (lent by Charles, Ketley, Esq., E. J. Hollier, Esq., and John Gray, Esq.); and casts of *Stylonurus* and *Pterygotus* from Forfarshire (from James Powrie, Esq., F.G.S.); exhibited by H. Woodward, Esq., F.G.S.

Siliceous skeletons of Carboniferous Limestone Corals; exhibited by H. B. Brady, Esq., F.G.S.

Teeth of a new species of Elephant; exhibited by the Rev. J. Gunn, F.G.S.

THE EDINBURGH GEOLOGICAL SOCIETY.—May 4th, 1865; David Page, Esq., F.G.S., F.R.S., &c., Vice-President, in the chair.—Mr. D. J. BROWN read a paper 'On the Geology of the Vicinity of Moffat.' He first described the surface-accumulations which had evidently been deposited in the bed of an old lake—a fact observed by Professor Jamieson. These accumulations consisted of mounds of gravel in which no animal remains had been found. He next described the Glacial Drift of the locality, and stated that it assumed a similar appearance to the Red Sandstone below it—the greater portion of this drift being derived from the *débris* of the sandstone; and, from a section which he had constructed across the valley, he showed that the drift lay conformable to the formation beneath. From the close resemblance of the one to the other, he inferred that should the Drift at some future period be consolidated into stone, no geologist could distinguish that formation from the one below it. From this he cautioned geologists against rashly concluding that two deposits were of the same age, even were their rocks of the same mineralogical texture, and even should the one lie conformably on the other. Mr. Brown then described the Red Sandstone, in which no fossils had been found. This sandstone, from its construction (an angular conglomerate), he inferred was produced by the action of Ice, and was deposited when the climate was much colder than at the present day. He then argued that the formation was of Permian age, and the equivalent of the sandstones of Corn-Cockle Muir. The whole of the other rocks in the neighbourhood, he said, belonged to the Lower Silurian period, but to what division has not yet been determined, for no other organisms than Graptolites have been found in them. There were good grounds for believing that with a more minute examination other organisms will yet be found. He had found what he believed to be the head of a small Trilobite at a place called Dobb's Linn, and the mark of a small bivalve shell at Garple Linn; but both of these were so imperfect, that they could not be specifically determined. They held out hopes, however, that others in a better state of preservation may yet be found. The Graptolites that Mr. Brown had collected belonged to four distinct genera; namely, *Rastrites* (1 species), *Graptolites* (8 species), *Diplograpsus* (8 species), and *Didymograpsus sextans.* He had also found three species that are yet undetermined.

Mr. ALEXANDER SOMERVILLE read a paper on the Ganoid Fishes of the Mid-Lothian Coal-field, in which he stated that the Ganoid Fishes are characterised by their cartilaginous skeleton, their bodies being covered and protected by bony plates or enamelled scales either of a round or rhomboidal form. He remarked that the genera belonging to the Palæozoic formations had the tail or caudal fin heterocercal or unequally lobed—a structure produced by the vertebræ being prolonged into the upper lobe of the tail, which is much larger than the lower. He stated that this order of Fishes is still represented in our present waters by the Sturgeon, the *Lepidosteus,* and the *Polypterus.* He then gave a description of the following genera occurring in the Coal-field of Mid-Lothian:—the *Rhizodus, Urone-*

mus, Megalichthys, Pygopterus, Ctenodus. Acanthodes, Palæoniscus, Amblypterus, Eurynotus. and *Platysomus.* The two principal localities in which these Ichthyolites occur are in the limestones of Burdiehouse, and the shales of Wardie, near Newhaven. He then exhibited specimens of the *Rhizodus.* portions of its huge jaws with both the serial and the laniary teeth, the head-plates, scales, &c.; also specimens of the *Megalichthys.* and of the different species of *Palæoniscus, Amblypterus,* and *Eurynotus*; and scales of an undescribed species occurring at Edmonstone. He noticed also the occurrence of coprolites of Fishes in these beds, many of which still retain the spiral markings of the intestines; others contain the indigestible remains of scales, and teeth of the smaller species which had been devoured. Specimens of coprolites were exhibited from Burdiehouse and the Wardie shales.

BRISTOL NATURALISTS' SOCIETY.—*Geological Section,* March 30; Mr. S. H. Swayne in the chair.—Mr. STODDART called the attention of the members to a fine section of the Lias that was then exposed in the White Ladies' Road, at the back of West Park Road. Numerous fossils had been collected, characteristic of the division known as the *Bucklandi*-series; but the point of most interest in connection with it was an observation made by Mr. SANDERS, who had found in that small tongue of the Lias an anticlinal, or curve of the strata, produced by some disturbing cause.

Mr. STODDART then read a paper *On the Upper Beds of the Lower Silurian Series,* illustrating it with a complete series of fossils. The Bala beds in Merionethshire were fully described and explained by sections, and the different localities suited for study were pointed out. The beautiful Cystideans and other Echinoderms that abounded in these beds were explained, and their analogies shown. After a description of the Caradoc and Lower Llandovery beds, with their fossil contents, the author concluded his paper by giving a brief summary of the early life upon the earth, showing how gradual had been its development, and that as yet not the slightest trace of any vertebrate animal having lived in those immensely distant ages had been found.—*Bristol Daily Post,* April 20, 1865.

DUDLEY AND MIDLAND GEOLOGICAL SOCIETY.—I. On April 25th, a Field-meeting was held at Hednesford and Cannock Chase, which was attended by about sixty Members. The party spent the whole day in examining the various new workings which are being opened in the northern portion of the Coal-field, and which are destined ere long to make this a most important district, and a busy centre of industry. The works of the Hednesford Colliery Company (where the plant, engines, &c. are of the most modern and improved character), and the sinkings of the Cannock and Rugeley Company, were more especially examined. At the former place, a most interesting open working in the Upper Coal-measures yielded many specimens of Fish-remains.

II. On Tuesday, May 2nd, at the Ordinary Monthly Meeting of

Members, it was stated that the Society now numbers nearly 400 Members. A paper was read *On the Application of Improved Fire-bars to Puddling and Heating Furnaces.* A new species of Trilobite, a Carpolite, and a Cystidean were exhibited.

III. The Second Field-meeting was held May 16th, about sixty Members being present. The party was conveyed from Stourbridge by special train to the junction of the Hayes Mineral Branch Railway with the Stourbridge and Birmingham line. The first point of interest was an adjacent cutting on the Hayes Branch, in which all, or nearly all, the seams of coal found in that part of the district are exposed, lying at a high angle of inclination. The Thick-coal is well exhibited. A line of fault runs immediately eastward of the cutting, and throws down the measures on the Cradley side in some places about a hundred yards, as is proved by a number of workings contiguous to the fault. Three pits on the Hayes Estate, and very close to each other, were visited, in which the rapid deepening of the beds from the Hayes Limestone eastward is proved. In the first the fire-clay is only about 12 yards deep, in the second it is 60 yards from the surface, and in the third the same bed is 160 yards from the top. The small patch of Silurian Limestone belonging to the Ludlow series next occupied the attention of the geologists. The Aymestry Limestone is the most conspicuous in this district. The other exposures of the same formation are at Turner's Hill, and along the western flank of Sedgley Beacon. The beds here dip to the east, and occupy but a very small area. These low-lying rocks have doubtless been brought in by the upheaving force which produced what is known as the Netherton Anticlinal or Saddleback, the effect of which was to tilt up the measures on each side of a line extending from Netherton through Quarry Bank to the Lye. A considerable number of fossils were obtained, consisting of fragments of Trilobites, Cup-corals, Shells, &c.: in all, twenty-four species of fossil forms had been made out in the short search. The party then proceeded up a pleasant hill which until recently seemed a barrier to the miner; but now a colliery has been opened, near the summit. The new sinkings on the hill belong to the Cradley Colliery Company, and the plant is of modern construction, embracing all the improvements which have recently been introduced in the winning of coal. The winding gear is worked by two coupled horizontal engines, working to 60-horse power. The mines have been sunk 188 yards to the fire-clay. The Brooch-coal lies at a depth of 132 yards, and the Thick-coal at 153 yards. The measures have yielded a good deal of water, but appear to be in a perfectly horizontal position, which is strong presumptive evidence that they extend evenly under the Red rocks farther to the south. The Thick-coal is here about 14 yards in thickness, including partings; so that there seems little danger that this fine seam will be found greatly split up in its southern extension. Mr. King explained briefly the principal points in the section of the shafts, and also in connection with the plant; and the party then passed down to the mines and extensive fire-clay works of Messrs. Harper and Moore,

er Delph. The new sinkings on Horner Hill, Cradley, were
visited. This is altogether a new mining centre, though
ally belongs to what may be termed the Coal-field proper.
rs. J. Evers and Sons have commenced operations, and have
dy reached the Brooch-coal, at a depth of 116 yards. Mr. J. E.
dell, the senior member of the firm, met the party, and ex-
ed the most noteworthy features in connection with the colliery.
engine-house is a very lofty and spacious building. The engine
vertical construction, 40-horse power, with 4-feet stroke, and
ders 22 inches in diameter. There is a self-acting steam-break,
hich the possibility of over-winding is very ingeniously pre-
ed. Great interest was shown in the inspection of these plants,
h afford such a marked contrast to the rudely constructed ap-
ces which South Staffordshire has long been content to use; and
to hoped that not a few will be impressed with the advisability
dopting the modern improvements, whenever new sinkings are
menced. Mr. Swindell justly observed, that it was high time
h Staffordshire should cease to be contented with the clumsy
ods of getting coal which have been so long in use. On the
of the adjoining hill, commanding a fine prospect of the south-
ern part of the Coal-field, the Rev. J. H. Thompson gave an
ess on the botanical and geological features of the district.

he principal geological facts connected with the district were
lly explained, and illustrated by numerous diagrams and sections.
he close, a vote of thanks was given to Mr. Thompson for his
resting address; and the party then proceeded to the new British
Company's works at Congreaves. Here they spent a short
in examining the engine; after which the two largest fur-
s were 'tapped,' and the process of casting was witnessed by the
nbers from the top of the furnace gangway. The Hawn new
ings (belonging to the Company) were next visited, the parties
ing along the newly constructed railway. The works are here
just commenced, and at present are stopped until the pumping-
ne is erected to carry off the water, which is rather abundant.
as found absolutely necessary to leave out the latter part of the
gramme, which referred to the sinkings at Manor Farm, near
es Owen.

inner was provided at the Shenstone Hotel. The Venerable Arch-
on Hone occupied the chair, and, after dinner, proposed a vote
hanks to the gentlemen who had so kindly given assistance to
Society during the day. These were—Mr. James Fisher, The
es; Messrs. King Brothers, and Messrs. Harper and Moore, Crad-
Park; Mr. J. G. Swindell, Homer Hill; Rev. J. H. Thompson;
J. P. Hunt, Corngreaves.

he next meeting is to be held at Oxford and its immediate neigh-
rhood.—*Birmingham Daily Post*, May 18.

V. The Annual Meeting was held on Tuesday, June 6th, at the
seum, Dudley. The report for the past year states that Field-
tings have been held at Cannock Chase, Cheltenham, Llangollen,
gley, Great Barr, Warwick, and Hednesford. Meetings of Ordi-

nary Members have been held on the first Tuesday in each month, and the papers read at these meetings have been issued quarterly in the Transactions of the Society. The present Member-list shows 35 Honorary, 125 Ordinary, paying one guinea per annum, and 224 Field-club Members, paying five shillings a year. The income for the past year has been £177 9*s.* 6*d.*, and the expenditure £161 3*s.* 0*d.*, leaving a balance in hand of £16 6*s.* 6*d.*

Earl Dudley was re-elected President, and Mr. John Jones Secretary. The Committee for the ensuing year was also elected; and after votes of thanks to the late Committee and the Chairman, the proceedings terminated.

NORWICH GEOLOGICAL SOCIETY.—At the last Monthly Meeting of the above Society, the Rev. John(Gunn, President, in the chair, the various objects which lay on the table for examination were commented upon. The first was a portion of a bovine or cervine cranium, with horns attached, from the collection of Miss Gurney. A discussion took place respecting a fossil tooth, found in the river-mud, near the Cow Tower, and presented many years ago to the Norwich Museum. It was thought to be the tusk of a large species of Boar.—Mr. Williams exhibited two vertebræ of *Platax*, and a piece of Lignite, from Bramerton. Mr. Gunn stated that he had lately discovered a fine tooth of the *Mastodon* at Horstead.——A paper, by Mr. TAYLOR, was then read, *On a Displacement of the Chalk at Whitlingham.* After offering some general observations on the physical characters of the Chalk, Mr. Taylor said—The 'White House' at Whitlingham is so well known to all Norwich people, that nothing further need be said concerning it. If a person, starting thence, should walk along the river-side, he will see on his right hand several quarries, all of which are now deserted except one. Here the Chalk-beds come up, and are, in many places, capped with about four inches of Norwich Crag, containing the usual marine shells. The Chalk-beds appear to lie in nearly a horizontal position generally. A new cutting, however, which has recently been made during the alterations in the grounds of Mr. Harvey, reveals a very interesting phenomenon. At this section the layers of Chalk, instead of lying horizontally, form *an anticlinal* or saddle-shaped *ridge.* Both the layers of Chalk, as marked by the thin film of oxide of iron which usually coats them, and the bands of flint, pass right over, and form the ridge above alluded to. In fact, this single chalk-quarry affords indications of a disturbance which has taken place in the strata. From a further examination, it may be seen that the bands and layers of flint are not shattered, neither are the strata at all broken. It will be further seen that the sand- and gravel-beds which overlie the Chalk do not seem to have partaken of any of the disturbances of the beds upon which they rest, but lie in the position in which they were originally deposited. Hence it is evident that the above disturbance took place *before* either the formation of the Norwich Crag, or the deposition of the Drift-beds.—*Norwich Mercury.*

THE MALVERN NATURALISTS' CLUB held its First Field-meeting on May 23, the country for examination being that well known as Bromsgrove Lickey. Mr. E. Lees, the Vice-President, in the temporary absence of the President, Rev. W. S. Symonds, led the party to the summit of the Beacon Hill, whence a fine view of the transverse ridge of the Lower Lickey Hills is obtained. Thence the party returned to Kendal End, where Mr. Lees read some observations on the Lickey quartz-rocks. At a quarry on the road to Kendal End, a singularly grand section of the Llandovery rocks was examined, at one part of which the strata are strangely contorted, but the general dip appeared to be to the south. Thence the party proceeded round the northern base of the Lower Lickey towards Rubery Hill, where they were joined by the President. After passing the base of Rendall Hill, the Club reached the Old Rose and Crown, where they halted for dinner.

After the ordinary business of the Club had been completed, the President delivered his annual address, in which he gave a *résumé* of the scientific progress and discoveries of the past year, special allusion being made to Dr. H. B. Holl's elaborate paper on the Malvern District (noticed separately), and the discoveries of flint implements in Drift in various localities in the West of England.

After a discussion in which Dr. Holl took part, the Rev. T. Smythe moved a vote of thanks to the Rev. W. S. Symonds for his able address, which, put by the Vice-President, was carried by acclamation. Mr. E. Lees then described the district over which the Club had passed that day. Dr. H. B. Holl made some remarks on the result of his researches in the Malvern Hills.

Arrangements were then made to invite the British Association to visit Worcester and Malvern in September, when Dr. Holl will lead the visitors to points of interest on the hills, and Dr. Grindrod will place his rooms and collections at the service of the Association.—*Berrow's Worcester Journal*, May 27.

RICHMOND AND NORTH RIDING NATURALISTS' FIELD-CLUB.—On May 15th, the President, Edward Wood, Esq., F.G.S., invited the whole of the Members to his residence in Frenchgate, Richmond. By eight o'clock, between 200 and 300 Members had assembled.

Mr. Wood first delivered a short lecture in the Museum, with special reference to the Ferns and other vegetable remains found in the Coal-measures. The lecture was intended as preliminary to a trip to one of the Durham Coal-mines which it is proposed to visit during the summer. The Members afterwards adjourned to the gardens, and inspected the extensive collection of living Ferns, which appeared in all their vernal beauty.

Mr. Wood gave a description of the Magnesium light, with illustrations, which terminated the evening.—*Yorkshire Gazette*, May 20.

CORRESPONDENCE.

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THE OUTLIER OF CARBONIFEROUS LIMESTONE NEAR CORWEN.

To the Editor of the GEOLOGICAL MAGAZINE.

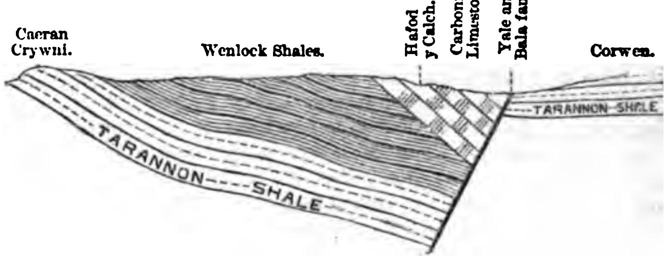
SIR,—Pending the appearance of Professor Ramsay's Memoir on North Wales, in which the conclusions arrived at by the Geological Survey will doubtless be fully stated, will you allow me briefly to give some of the reasons for believing that the outlier of Carboniferous Limestone near Corwen formed originally part of that which now sweeps round North Wales from Llany Mynech to the Great Orme's Head?

The country around Corwen was examined by Mr. Talbot Aveline and myself, who spent many pleasant but laborious months in it, so that not only was no rock-exposure unknown to us, but there was hardly a boulder with which one or other of us could not claim a personal acquaintance. If, therefore our conclusions are wrong (and I, for one, utterly abjure all pretension to infallibility), it is not that we spared our labour in examining the ground, and collecting data for arriving at them.

The patch of Carboniferous Limestone at Hafod y Calch is on the downthrow side of the great 'Yale and Bala' fault which cuts across Merionethshire and Denbighshire from SW. to NE. On examining the Survey section, sheet 39, it will be seen that the limestone dips to the NE., as mentioned by Mr. Davies,* and also that it rests unconformably on the Wenlock Shale, from beneath which the Tarannon Shale rises out, about 2 miles to the SW. On the SE. side of the fault the Tarannon Shale is at the surface close to Corwen, with the Wenlock Shale (or Denbighshire Grits, which in all this region form the base of that shale) just over it.

The rough diagrammatic section, fig. 1, will serve to give a general notion of the facts.

Fig. 1.



According to the section, there is a thickness of about 3,000 feet between the base of the limestone and the Tarannon Shale, which, with 500 or more feet of Carboniferous rocks, will give a downthrow to the NW. of 3,000 or 4,000 feet to the fault there. Now, suppose we imagine this *dislocation* to be *reduced* (to borrow a term from the surgery) by the simple process of lifting up the Tarannon Shale on the downthrow side of the fault, and putting it on the same level as the corresponding beds on the Corwen side of the fault, as suggested in fig. 2.

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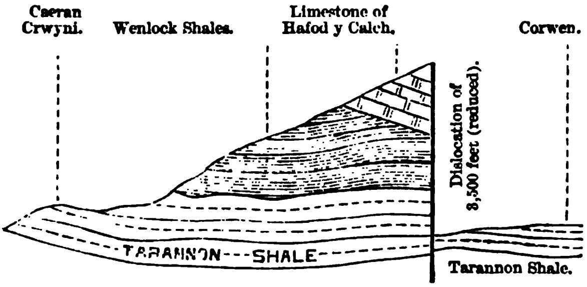
* See GEOLOGICAL MAGAZINE, Vol. II., p. 283.

Fig. 2.



We should then have a hill 3,000 or 4,000 feet in height capped by the Carboniferous Limestone; and anyone standing on that hill and looking to the east would see the limestone cliffs of the Eglwysegle rocks near Llangollen, with the ends of the beds facing right at him. Produce the beds about Llangollen with their mean rise of about 5° towards Corwen, and they would just be about 4,000 feet above the level of the country there.

It is therefore a by no means improbable supposition that the preservation of that little patch near Corwen is due to the joint action of the downthrow of the fault, and a local basin-shaped depression of the beds there. An undulation in the beds at that particular spot perhaps enabled the fault to bring down higher beds than it did just north of it.

The effect was, that the patch of limestone was there let down to such a low level into the earth, that the denuding forces which have ever since been at work have not yet destroyed it. It has been spared as if to prove to us that at the time when the great fault was produced, the limestone spread over the whole area.

Now when was that great fault produced? and when did the chief part of the destruction and removal of rock take place? The answer to these questions will entirely absolve us from the necessity of looking for the materials, and especially from searching for them in the Drift of the Glacial period.

Whenever the fault commenced, its production was finished before the time of the deposition of the New Red Sandstone. In like manner, although denudation has been taking place ever since the first elevation of the rocks above the sea, yet by far its greatest amount occurred before the deposition of the New Red Sandstone.

Let anyone walk from Corwen up the Nant Morwymon, through the Hundred of Yale, along the course of the great fault, past the broken limestones north of Cyrn y Brain and the division between the Denbighshire and Flintshire coal-fields to the plains of Cheshire: he will find the level beds of New Red Sandstone sweeping undisturbedly across the course of the fault, and resting in one place upon Permian beds, in another on Coal-measures, and in another on the Millstone Grit.

Let him walk into the pleasant Vale of Clwyd, and he will find the remains of the Carboniferous Limestone, which sweeps round the head of that valley in a beautifully symmetrical synclinal curve, covered in the centre of the valley by horizontal beds of New Red Sandstone. The Millstone Grit and the Coal-measures which once spread over that Carboniferous Limestone had been all swept away before the time when the New Red was deposited upon it.

What became of the materials would be a wild speculation even to guess at. Limestones would of course be redissolved and restored to the Ocean from which they were originally derived. They may have been resolidified and redissolved half a dozen times since then. The sandstones of the Millstone Grit may have entered into the composition of the New Red Sandstones. The Coal-measure clays may have been used up to form beds which have been destroyed and left no trace of their existence. Some of the materials may perhaps have ultimately entered into the compostiion of the Lias or other clays of the Oolites. *Quien sabe?* J. Beete Jukes.

To the Editor of the Geological Magazine.

Sir,—In No. X. of your Magazine (p. 181) there appeared an abstract of a paper by Mr. Thomas Smyth, 'On the Upheaval of the Shores of the Firth of Forth during the Human Period; with a notice of the recent discovery of flint weapons at Marionville (between Edinburgh and Portobello).'

Mr. Smyth states that he found 'Oyster-shells for a distance of a quarter of a mile from the shore, to a height of about 43 feet above the level of the sea . . . . . . beneath a stratified deposit of sand and gravel;' and that he 'had traced the same stratum, *though devoid of shells* [the italics are mine], to a height of a hundred feet.' Had Mr. Smyth looked into the writings of those who hold that, on the shores of the Forth, no evidence is apparent indicative of a recent rise, he perhaps would be convinced that the oyster-beds are storm-raised, and the sands above them not marine, but blown sand. Mr. Smyth goes on to say, 'I then, in the second place, mention the known upheaval of at least 25 feet since the time of the Roman occupation.' If Mr. Smyth, or any of your readers, will peruse a paper which I read before the Royal Society of Edinburgh on the 21st April, 1862, and published in the 16th volume of the 'Edinburgh New Philosophical Journal,' entitled 'On the Danger of Hasty Generalizations in Geology,' he will find that I have proved Mr. Geikie's views fallacious on this point, as that gentleman has not yet disproved my arguments. Further, if Mr. Smyth will honour me with a perusal of this paper, he will find that his arguments from the Ordnance Survey are there anticipated, but have led me to a different conclusion. With regard to his finding flint weapons at Marionville, this has no bearing on the question; as all it proves is that the aborigines formed their rude weapons after the sand was deposited by winds or river-action, but most certainly never by a *marine agent*, because utterly '*devoid of shells.*'

Mr. Smyth adds, 'Additional evidence, which I intend soon to lay before our Society, fully corroborates the facts I have adduced regarding the present rate of upheaval, and shows beyond a doubt that the whole southern shore of the Firth of Forth between Queensferry and North Berwick, a distance of twenty-eight miles, and that portion of the east coast which lies between North Berwick and St. Abb's Head, about twenty-four miles additional, have been upheaved more than two and a half feet within the last fifty years.'

From the Temple of Jupiter Serapis, at Puzzuoli, I extracted upwards of twenty shells of dead *Lithodomi*, whose burrows perforate the marble columns from the height of about 12 feet above their pedestals to at least 23 feet above high-water mark.*

Now, Mr. Editor, if Mr. Smyth, or Mr. Charles Maclaren, or Mr. Robert Chambers, or Mr. Geikie, or Sir Charles Lyell, or any other advocate of the theory that the shores of the Forth have risen since the human epoch, can show me the bore of a *Pholas*, with a dead shell in it, one foot above the present limit of Pholas-life so abundant on our shores, I will yield the whole argument to them. I have looked in vain for such evidence all along the shores of the Forth and Clyde, but have failed to find one; and I leave those gentlemen to prove that the *Pholadidæ* were imported by the Romans. Until this proof is produced, all the other arguments are futile.

I am, &c., ALEXANDER BRYSON.
HAWKHILL, EDINBURGH.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—May I ask the favour of the insertion of the following correction; or, rather, I should say, the following illustration of the familiar quotation, 'Ne sutor ultra crepidam'?

In the 'Geologist,' July 1860, the Editor obliged me by publishing this note:—

'CHEMICAL EVIDENCE OF THE SPONGEOUS NATURE OF FLINT FOSSILS.—If a flint coated with chalk be immersed in hydrochloric acid, the chalk will be dissolved and the flint will remain unaffected. In many instances, however, there is a point beyond which the acid, even if renewed, will not act, and a white coating is left which neither nitric, sulphuric, nor hydrochloric acid will touch. This incrustation I have found to consist of sulphate of lime. It is met with on those flints which contain fossils, such as sponges, &c. I have several specimens of laminated flint presenting this peculiarity.

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* See 'Lyell's Principles of Geology' (7th edition), chap. xxx. p. 486 *et infra.*

I have also a fossil Echinus from which the chalk has been entirely removed by acid, and on which the sulphate remains beautifully arranged only around the lines of orifices between the plates.

'May I presume to draw the inference that the above facts lend confirmation to Dr. Bowerbank's views on the spongeous basis of many flints? May they not also be adduced in support of the opinion that holds the animal nature of sponges? We know that animal substances are partly albuminous, and that sulphur is one of the elements of albumen. The animal substance, in undergoing decomposition, during or previous to fossilization, would part with its sulphur, which would be seized by the lime of the chalk in immediate contact with it, and hence the coating of sulphate of lime, for which I was totally unable to account, until Dr. Bowerbank was kind enough to impart to me some of the vast information he has amassed on the nature and habits of sponges, recent and fossil.'

I feel it to be due to your readers to state, that I have since found that there was a great mistake in my experiments, and that the insoluble substance left on the flint after the solution of the chalk by hydrochloric acid was not a sulphate of lime, but simply a modification of silica (the base of flints). With the supposed fact fall, of course, the inferences which seemed to lend support to views that doubtless stand in small need to be propped up by error. Had I been more thorough in experimental chemistry, I should not have made this blunder; had I been wiser, I should not have ventured 'beyond my *last.*'—I remain, &c. W. B. KESTEVAN, F.R.C.S.

UPPER HOLLOWAY, LONDON.

MISCELLANEOUS.

ALLEGED GOLD-FIELD AT THE HEAD OF THE NEPEAN RIVER, NEW SOUTH WALES. By the Rev. W. B. CLARKE, F.G.S., &c. (Extracted from a Letter to the Editor of the *Sydney Herald.*)—The eastern boundary of the plateau in which the Macquarie and the Nepean rise is the escarpment which backs the Illawarra, where it is about 2,000 feet above the sea, and the Nepean waters falling westerly from the edge collect in a channel which runs to the northward, other branches falling from the northern slope of the Mittagong more to the westward, towards the road to Bong Bong, and not far from where it leaves the Berrima road at Little Forest.

The Cordeaux River collects in numerous heads along the edge of the escarpment farther to the north, and the back of Mount Kembla, and finally it joins the Nepean at the Pheasant's Nest. At one spot Nepean waters collect behind a ridge, not more than fifteen chains distant from the swamps of the Cordeaux. Intermediately, a Nepean water rises near Geringulli Mountain, where the elevation is about 1,800 feet above the sea, and runs at first northerly, and then turns to the west to join the main stream. The whole extent of the coast-range thus supplying the watershed of the Nepean itself is from four to five miles. The coast-range is there precipitous and broken, and about the heads of the Cordeaux is depressed, so that behind Kembla it only attains an elevation of about 1,320 feet.

The upper portion of the rocks forming this broken and lofty plateau is composed of '*Hawkesbury rocks*' (such as occur about Sydney), and below these sandstones come in the Coal-measures of the Illawarra in regular sequence; the lowest members of the series being the fossiliferous beds, equivalents of the Lower Carboniferous rocks of Europe.

Masses and dykes of basalt and other similar igneous rocks have broken through this series, and have formed insulated hills on the plateau—such as Wanyanbilli, and others between the heads of the Cordeaux and the Mittagong, to the westward. That range is composed of igneous rocks, such as trachyte, basalt, and porphyry, and of metamorphic rocks which have been altered by the action of the former. Besides these, the whole surface of that wild, broken country, which is in parts densely wooded, consists of the Hawkesbury rocks, and patches of alluvia or drift. There are no slates nor any quartziferous rocks besides the pebbly conglomerates of the Hawkesbury beds, except the altered hardened sandstone and shale from the base of Mittagong, and of which the drift is composed.

The sandstones and Coal-measures occur in the same way on the south side of the Mittagong, and are similarly interspersed with trap-hills, such as Kinnoul; or porphyry, as at Mount Broughton.

Farther from the coast, numerous hills of igneous rock break through, or are covered at their bases by the formations previously mentioned, from the fossiliferous beds to the coal and the Hawkesbury beds, with here and there indications of the Wianamatta beds, which, though filling in the centre of Cumberland, and forming Razor Back, only reach in patches the elevations of the Mittagong.

Such, then, is the country in which the alleged gold-field occurs. The interior features, as described by me, do not appear on Sir T. L. Mitchell's map. But I give them from my own explorations, having made myself familiar with all that part of the country by frequent traverses, and barometrical measurements of the heights.

I may add, that the nearest point at which I know true slate rocks to occur is in the lower part of Bundanoon Creek, which rises ten or eleven miles south of Berrima, and falls into the Shoalhaven.

Over all this region, on both sides of the Mittagong ranges, there are drift-patches and occasional alluvial deposits in hollows and creeks. And it is, therefore, not extraordinary, that such being the case, and bearing in mind the auriferous region farther south, here and there particles of gold should have been deposited, when the local drift and that from a loftier horizon were distributed.

Primâ facie, then, there is no argument against the possibility or probability of some gold occurring in any of the head-waters of the Nepean.

But that there should be any other than drift-gold, whether local or otherwise, is very unlikely, for the reasons I have stated.

The fact that minute portions of gold do exist in various points in the Mittagong region has long been known to me; and in the 'Researches in the Southern Gold-fields,' I have, at pages 44, 245, and 249, pointed out not only its probable occurrence there, but also at the base of the Carboniferous formation at Wingelo, where it was found by Sir T. S. Mitchell (and near which it has been worked since that time), as well as on the Hawkesbury rocks themselves, as at St. Leonard's, not far from my residence (though in quantity too minute for profit), and at Govett's Leap, on the Grose River, in a small conglomerate of quartz pebbles cemented by iron, such as covers much of the surface near the reported new gold-field. In these instances the gold is only procurable by analysis. This condition of things should be sufficient to prevent the expectation of an *alluvial gold-field* derivable from our sandstone beds; though there is nothing to prevent the possibility of gold *over* them, if there be in the vicinity true gold-bearing rocks of sufficient richness to allow a local drift worth working.

I come now to my examination of a portion of gold from the Nepean diggings, procured during Mr. Commissioner Johnson's visit, and which, together with the clays in which it is said to occur, I have minutely scrutinized.

The yellowish-white clay, or washing stuff, turned out to be a collection of very minute clear atoms of quartz, some of them coloured by iron, and all bound together by a yellow clay, which when dry gives a character to the mass. I could detect no gold in it, nor other metal.

The darker clay has nothing in common with *slate* of any kind, and I do not believe any will be found below it.

The dust is so fine that the greater part is microscopic. By careful examination under the instrument, I detected not only *gold*, but *platinum* (white, hard, and magnetic); *oxide of tin*, *corundum*, *ruby*, *topaz*; *specular*, *titaniferous*, and *magnetic iron*. The gold particles were the largest, next were corundum and platinum. The first was in rough but bright rounded flakes, scarcely at all abraded, and betraying only a few scratches; so that it had probably only drifted a very short distance from its matrix, which certainly was not a quartz reef.

I use this occasion to lay before the public some facts recently ascertained, which may be of use.

Independently of the alluvial or drift gold of the Australian diggings, of the gold extracted from the quartz reefs of the Silurian formation, which are the great sources of wealth, and from the 'cement' of quartz pebbles and ironstone which is so common in certain parts of the Carboniferous formation, and of the other minor *habitats* referred to above, I have discovered gold in the quartz pebbles of the shelly calcareous *Secondary* rocks of Queensland. So that even in Australia gold is known to *exist* in the *Tertiary*, *Secondary*, and *Palæozoic* formations. My discovery of gold in the Secondary fossiliferous rock of the Fitzroy Downs, and the fact that gold has been also found in alluvia over *Secondary* rocks at the head of the

Barcoo River, enable me to remove all *primâ facie* objection to a statement made by the late Mr. Commissioner Mitchell, and quoted by Sir Thomas Mitchell, that he had found a particle of gold in the neighbourhood of Mount Abundance. What I procured came from that neighbourhood. These facts prove, however, that a view I have always entertained is a right one, namely, that *gold was not introduced into the quartz reefs so lately as the Tertiary epoch*; for we have quartz pebbles with gold in rocks of *Secondary* age. And though the distinct period in which those Secondary formations of Queensland were deposited is not yet satisfactorily made out, yet from the the occurrence of Belemnites and Ammonites in the same beds with the gold-bearing quartz pebbles, we know that if not Cretaceous, they are probably Jurassic, or possibly Triassic.

That in the Carboniferous formation gold should occur is, therefore, less and less surprising. Indeed, the question admits now of no doubt whatever. For in New Zealand one of the Nelson gold-fields is along the Waimangaroha River; and that river not only rises in the Carboniferous formation (which is based on granite), but *runs altogether through a coal-field*; and this was reported to the Nelson Government by Mr. Clouston in September 1862. Sections across the gold-field show no interpolation of intermediate formations. Further, Mr. Gould has reported to the Tasmanian Government, that he had actually found a particle of gold in *a coal-seam*; and this he exhibited to the Royal Society of Tasmania. Perhaps this was set free by the decomposition of bi-sulphuret of iron so common in coal, and a source of gold in older rocks. To say, then, where gold may not be found is very difficult.

Further, I would now mention what, to many of your readers, may appear extraordinary. It has been impressed upon the public mind that, some fourteen years ago, gold was found in New South Wales, on the strength of convictions that the rocks in California producing gold in abundance were the *same* as those in which it was looked for in this colony.

The American Government, wishing to set at rest doubts that have occurred as to the age of the Californian gold-rocks, sent out lately Professor Whitney to report on the geology of California.

As his report has not yet been published, I cannot refer your readers to the book itself; but I mention, as derived from a not less direct channel, these facts. He discovered that *very little if any of the gold of California belongs to the Silurian formation*; that it is found in very considerable abundance in the *Trias*; but that *the greatest amount* belongs to the altered rocks of the Cretaceous epoch. So that, in fact, the wonderful riches of California are derived chiefly from formations *above* the Upper Silurian, whilst here the *Lower Silurian* rocks are the chief sources of supply.

The Tertiary and Pleistocene drifts are common to both regions.

These very recent discoveries are no doubt suggestive, and will, perhaps, be turned to account.

GOLD-FIELDS IN NEW ZEALAND.—No mining news of any especial importance has reached us from New Zealand for some time past. Work is now very steadily prosecuted on the different gold-fields in Otago; still the total yield is falling off. The Wakamarina also has been partially deserted, no new discoveries of any importance having been made near it lately. The diggings on the west coast are, however, improving as the season advances, two steamers having arrived at Nelson in one day with 1,415 oz., which had been purchased within a few days at the Okitiki. This is near the Grey, and between 700 and 1.000 miners are now at work. They declare themselves to be satisfied with their returns, but no very rich ground would appear to have been opened by them as yet.—*Colonial Newspaper*, April 1865.

DISCOVERY OF AN ALMOST ENTIRE SKULL OF RHINOCEROS LEPTORHINUS, AT ILFORD. ESSEX.—A very fine skull of the ***Rhinoceros leptorhinus*** of Cuvier and Owen has recently been found in the Uphall Brickfield, Ilford, and in close proximity to the spot where the skull and tusks of the Mammoth were discovered, which were secured last autumn for the National Collection. The head is nearly perfect, and is that of a rather aged adult, judging by the worn condition of the teeth, of which the whole series on both sides are preserved ***in sitû***. The fossil is not only interesting as being the finest specimen of the species yet recorded as found in England, but also as affording conclusive evidence of its having been contemporaneous with ***Elephas primigenius***. This specimen will probably enable the palæontologist to determine with certainty the species of Rhinoceros to which the limb and trunk bones belong, that are found scattered and intermixed with those of the Mammoth, Ox, Horse, &c. in the Ilford beds, and which are of much more slender proportions than those of ***Rhinoceros tichorhinus***.

The specimen forms part of the fine collection of Mammalian remains from the above locality belonging to Antonio Brady, Esq., F.G.S., of Maryland Point, Stratford, who has also a lower jaw of probably the same species, but found in another Brickfield just through Ilford, on the Romford Road.—W. D.

MORE DISCOVERIES OF FOSSIL REMAINS OF THE ELEPHANT OF MALTA.*—The explorations by Dr. Adams among the cave-deposits and alluvial soils of this island have been lately crowned with signal success. It will be remembered that Captain Spratt, the indefatigable and learned hydrographer of the Mediterranean, was the first to bring to light the remains of the unique and remarkable Fossil Elephant of Malta (***Elephas Melitensis***), by his explorations in the Zebbug Cave, in 1859. Since that time, Dr. Adams has been unremitting in his exertions to discover more remains of this extinct species, and has been fortunate enough to find them in many new localities in Malta. He has just met with its teeth in great quantities, in a cavern near Crendi. In another gap, evidently at one time the bed of a torrent, he has found the teeth and bones of thirty more individuals. These skeletons of old and young Elephants are met with jammed between large blocks of stone, in a way that clearly shows that the carcases must have been hurled into their present situation by violent floods or freshes. He has now brought together almost the complete skeleton of this wonderful little representative of an order of quadrupeds, to which we had, until the Fossil Maltese Elephant appeared, applied the word gigantic. There can be no doubt, however, that it scarcely exceeded a small pony in height.—*Malta Times Supplement*, March 16, 1865.

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* See GEOLOGICAL MAGAZINE, No. III. p. 140.

Professor AGASSIZ intends to undertake a Scientific Exploring Expedition to the Tropics, with eight scientific companions, for the purpose of testing the Glacial theory suggested by him, which, if correct, will enable the observer to mark as upon a thermometer the change in temperature the earth has undergone. As one of the results of the expedition, he expects to bring home the largest collection of tropical specimens that has yet been collected. The Emperor of Brazil will, it is expected, furnish unwonted facilities to the Expedition. The expenses of the party (from 2.500 to 3,000 dols. each) will be defrayed by the liberality of Mr. Nathaniel Thayer, of Boston. —From the '*Boston Traveller.*'

OBITUARY.

SIR JOHN RICHARDSON, C.B., M.D., D.C.L., F.R.S., &c. &c.—To the list of those distinguished men who have been lost to science during the past year, must now be added the name of the Arctic Explorer, Sir John Richardson, C.B.

Born at Dumfries in 1787, of which town his father Gabriel Richardson was Provost, he was educated in its Grammar-school, and thence, in 1801, he entered the University of Edinburgh, where he graduated as an M.D. in 1816. He entered the Navy as an Assistant-Surgeon in 1807, and served at the bombardment of Copenhagen, and during the war with the United States in Canada and Georgia, as Surgeon to the 1st Battalion of Marines.

In 1819, he accompanied Captain (afterwards Sir John) Franklin in his overland Arctic expedition as Surgeon and Naturalist; and again in his second expedition in 1825, when he commanded two boats, with which he discovered a passage between the mouths of the Mackenzie and Coppermine Rivers. After nearly two years of severe toil, he returned in 1827, and published an account of the part he took in the enterprise: his narrative is attached to the great work produced by Captain Franklin.

He became, in 1838, a Physician to the Fleet, and, in 1840, Inspector of Naval Hospitals. He was knighted in 1846.

In 1847, in consequence of no tidings coming of the 'Erebus' and 'Terror,' then in the Arctic regions under command of Sir John Franklin, K.C.H., who had sailed from England on May 19, 1845, three expeditions were sent out by the British Government, the command of one of which was given to Sir John Richardson.

This, like his former expeditions, was overland. Accompanied by Mr. John Rae of the Hudson's Bay Company, he, in July 1848, descended the Mackenzie River, and explored the coast between its mouth and that of the Coppermine River. In 1849, he proceeded to the Great Bear Lake, and afterwards to Great Slave Lake, whence his party returned by their former route to Canada.

In 1851, he published his 'Arctic Searching Expedition: a Journal of Boat-Voyage through Rupert's Land and the Arctic Sea, in search of the Discovery Ships under command of Sir John Franklin,' &c.: 2 vols. 8vo.

Besides this, especial mention must be made of his great zoological work, the 'Fauna Boreali-Americana,' 4 vols. 4to., 1829–37 in the labour of which Swainson and Kirby shared. He also described the 'Fossil Mammals' for the Zoology of H.M.S. 'Herald,' Captain Kellett, R.N., C.B., Commander.

His last important literary work was the article 'Polar Regions,' in Black's Cyclopædia, since published separately in a large 8vo. volume.

Most of his valuable collection of zoological specimens, first lodged in Haslar Hospital, Gosport, are now in the British Museum; and upon the occasion of his last visit, he presented to the Geological Department a fine series of Fossil Leaves obtained from a bed of pipe-clay associated with coal-beds of Tertiary age on the Mackenzie River, between Fort Norman and the mouth of the Bear Lake River. This coal is constantly on fire, from spontaneous combustion, at some part of its exposed surface, and the pipe-clay has become porcellanous from the intense heat of the subjacent coal. Sir Alexander Mackenzie observed these beds on fire, emitting much smoke and flame, in 1785;* and they were still burning in 1849. Sir John Richardson gives two plates, in his 'Arctic Searching Expedition,'† of these leaf-impressions on the surfaces of indurated pipe-clay from this interesting deposit. The specimens have been examined by Dr. O. Heer of Zurich, who was able to identify several species of trees now quite unknown in these extreme northern latitudes. Among them were—*Corylus grossidentatus*, Heer; *Hedera Richardsoni*, Heer; *Acer otopteryx*, Göppert; *Taxites acicularis*, a species of *Salix*, and seeds of *Sequoia Langsdorfi*. Mr. J. Walter Tayler has noticed a similar formation at Omenak Fiord, North Greenland, specimens from which may be seen, with those from the Mackenzie River, in the British Museum.

Sir John Richardson died on the 5th June, at Lancrigg, Grasmere, in his 78th year.

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* See Sir Alexander Mackenzie's description, in his Voyage of Discovery down the Mackenzie; also Appendix to Sir John Franklin's Second Overland Expedition.

† Vol. i. p. 186 *et infra*; and ii. p. 403.

THE

GEOLOGICAL MAGAZINE.

No. XIV.—AUGUST 1865.

GEOLOGICAL PROGRESS. No. 2.

FIELD-CLUBS AND LOCAL GEOLOGICAL SOCIETIES.

EVERY good general looks from time to time to his 'muster-roll,' to see that his force maintains its efficiency; and it behoves the Geologist no less, who sees his front ranks thinned by the loss of such men as Horner, Portlock, Falconer, Bronn, Hitchcock, and Woodward, to look to his reserves for fresh investigators to fill their places and keep up the efficiency of our great Geological army.

One of the best sources of supply must of necessity be looked for among the members of the Geological Survey, a corps composed of picked men from all parts, and whose position in the country affords them opportunities superior to those of any other class of students. But, although special training is most important, we must remember that some of our very best living Geologists are men who first became noted in connection with their own district; and having worked that well, they were better fitted to comprehend a wider field. Professor Ramsay, for example, was chosen Local Director of the Geological Survey of Great Britain in 1845, through having made himself a name as a Scotch Geologist by preparing model maps and sections of the Island of Arran, which attracted general attention at the Glasgow Meeting of the British Association in 1840, and directly influenced his translation from Glasgow to the head of the British Survey. Bristol can also take credit to herself that one of her best-known local men is now Palæontologist to the Survey.

Thus it seems to us that, in looking over the work done by the Field-clubs, we are watching the progress of rising men in various districts; and although some, like Dr. Wright of Cheltenham, are among the local veterans, yet many more are young men who may eventually attain to the highest position in Geological Science, and become in the future some of th most celebrated of our metropolitan magnates.

As a young society, we cannot but speak in the highe terms of the Geologist's Association. Each report of their pr ceedings shows a step in the right direction—onwards. In th last number, Mr. W. Hislop contributes three papers on Micr scopic Geology (illustrated by a plate), in which he gives a ver good account of the wonderful range in time and space of tho minute organisms, the *Diatomaceæ* and *Foraminifera*, whic contribute so largely to make up the entire thickness of som of the most extensive formations throughout the world.

The Dudley and Midland and the Manchester Geologic Societies number amongst their members such able Geologist and so many who are practical miners also, that their meetin generally produce material of considerable value. We, how ever, deprecate very strongly the use of 'slang' expressions b gentlemen when lecturing on Geology, and especially so whe there is an equally liberal number of quotations from Scriptur neither of which are needed to introduce Mr. Henry Beckett very excellent paper 'On the South Staffordshire Coal-field.'

The Cotteswold Naturalists' Field-club contains, amon other contributions, an article by Mr. R. Etheridge, Pala ontologist to the Geological Survey, 'On the Rhætic *Avicula contorta* Beds at Garden Cliff, Westbury,' illustrate by a carefully prepared coloured section.[†]

There is also a paper by Dr. Wright 'On the Ammonites the Lias Formation,' accompanied by two well-executed quar plates by Mr. J. W. Salter, F.G.S. The undertaking of suc a work as a series of quarto plates of the Oolitic Ammonite four of which have already appeared, displays an amount spirit on the part of the Cotteswold Club which is highly com mendable: we, however, fear much inconvenience will ari from the text and plates being of two sizes (8vo. and 4to.).

A very interesting feature of progress is the establishme of a Geological Society at Norwich under the presidency of th Rev. John Gunn, F.G.S., who for upwards of thirty years ha devoted himself to the geology of his native county, especiall with reference to the mammalian remains from the Forest-be at Hasbro', the complete examination of which was one of th unfulfilled labours of the late Dr. Falconer. We are informe that it is Professor Owen's intention to take up the investig

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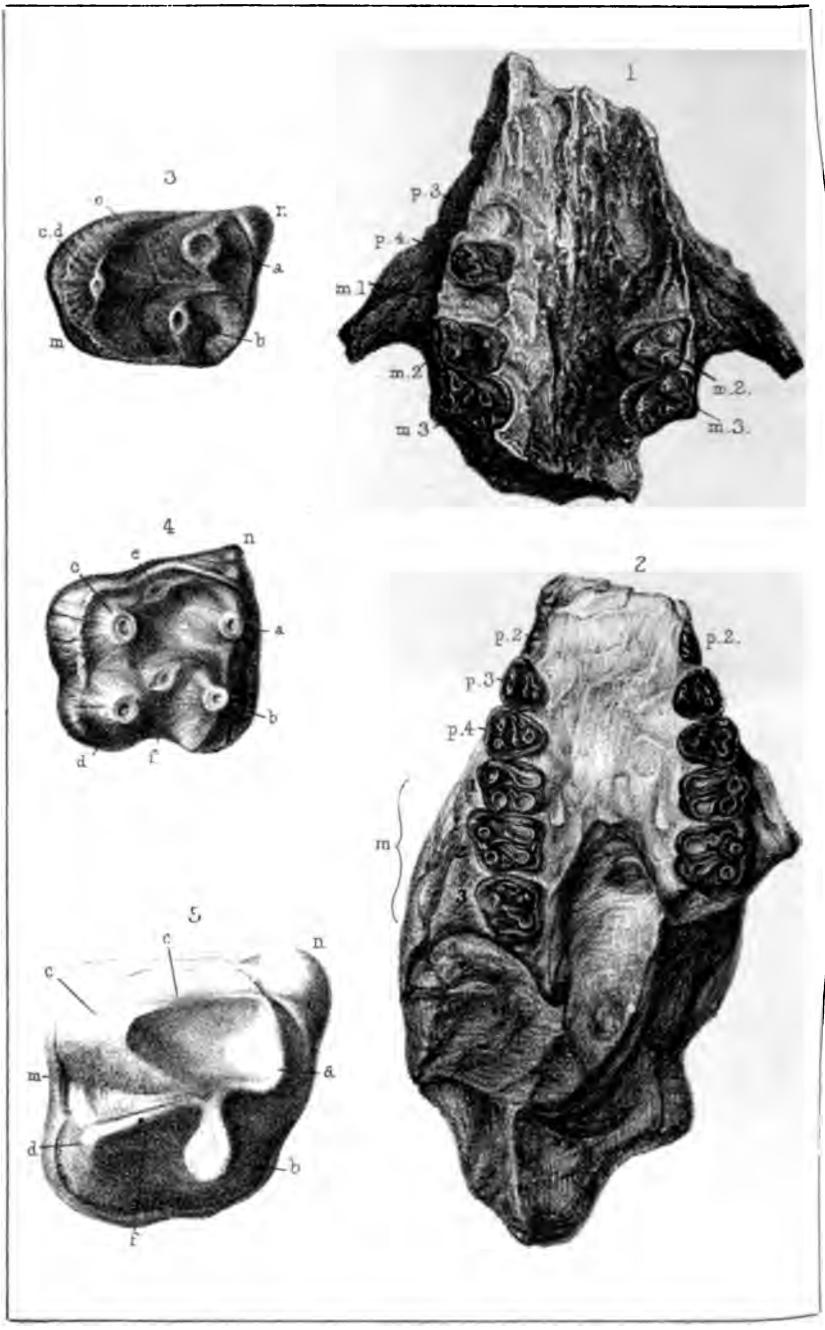
[*] See Trans. Dudley and Midland Geological Society, No. 5, vol. ii., Februa 1865.

[†] See Geol. Mag., Vol. I. p. 237; Report of Mr. Bristow's paper on the Rhæt Beds, read before the Brit. Assoc. 1865 (with section).



E.M.Williams F.L.S. del et Sc. M & N Hanhart imp.

FOSSIL MAMMALIA FROM THE [illegible] CLAY.

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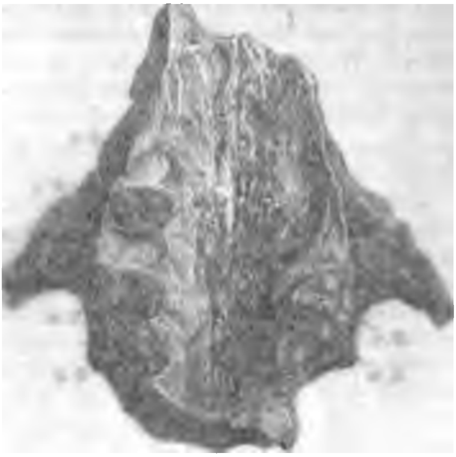

tion of these very interesting remains, of which Mr. Gunn's collection and that of the Norwich Museum contain so fine a series. We are glad also to note that Mr. John Taylor, of Norwich, is very earnestly working in this field of research, where little has been done in the way of geological investigation since Mr. C. B. Rose, F.G.S., and the late Mr. Samuel Woodward laboured together.

We shall not speak now of the work going on in Glasgow, Edinburgh, Liverpool, or Dublin, where first-rate local geologists are constantly turning up fresh ground and recording new facts for future generalizers to make use of, for the pages of the GEOLOGICAL MAGAZINE during the past year fully testify to the activity and zeal of these societies. Anyone who can read the signs of the times can see for himself that the progress of Geological Science is no fiction.

ORIGINAL ARTICLES.

I. ON A NEW GENUS (*MIOLOPHUS*) OF MAMMAL FROM THE LONDON CLAY.

By PROF. OWEN, F.R.S., &c.

[Plate X.]

I HAVE been favoured by Mr. G. E. Roberts with the inspection of a fossil from the London Clay of Sheppey, which indicates a genus of mammals distinct from *Pliolophus* and *Hyracotherium*, to both of which it is nearly allied. It consists of so much of the upper jaw (Plate X., fig. 1) as includes the six sockets of the molar series of each side, with the intervening bony palate and the anterior piers of the zygomatic arches: the upper part of this portion of skull has been crushed and filled up with compact septarian stone. The last, *m* 3, and penultimate, *m* 2, molars of both sides, and the last right premolar, *p* 4, remain in their sockets. In point of size they differ from those teeth in *Hyracotherium leporinum* in about the same degree as do those of *Hyracotherium cuniculus*,* but exhibit a modification of generic value. Instead of having a pair of inner cusps corresponding with the outer pair, a single cusp, fig. 3, *c*, *d*, is largely developed, forming almost the inner half of the grinding surface of the crown: the inner side of the base of this cusp is bordered by a 'cingulum' relatively broader than in *Hyracotherium*, and complicated by many small ridges, which run up to and are lost upon the base of the large cusp. The largest of these ridges of the 'cingulum' developes a small talon, *m*, at the hind part of the base of *c d*, which might be regarded as a reduced homologue of the postero-internal cusp, *d*, of *Hyracotherium* and *Pliolophus*; but there is no trace of ridge connecting it with the postero-external cusp *b*. The two outer cusps, *a* and *b*, and the outer part of the coronal

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* 'Brit. Foss. Mamm.,' p. 424, fig. 170.

'cingulum,' resemble those parts in *Hyracotherium* and *Pliolophus*, but are more irregular and wrinkled. Besides the original specimen of the upper jaw of *Hyracotherium leporinum*, figured in my 'British Fossil Mammals,' p. 422, figs. 166, 167, I have been enabled to strengthen the results of the above comparison, by extending them to a second specimen of that rare genus and species, from the London Clay at Herne Bay, now in the British Museum. This specimen consists chiefly of the maxillary part of the skull, and includes, *m* 1, 2, 3, *p* 4, and *p* 3, of the right side; *m* 2, *m* 1, *p* 4, *p* 3, and part of the crown of *p* 2, of the left side: it is from an older animal than the one first described, the crowns of the molars being worn down to the cingulum; and, as a tract of dentine is exposed continuously along the connecting ridges to the inner cusps, the resemblance to the pattern of grinding surface in the genus *Lophiodon*, fig. 5, is made greater.

In this specimen of *Hyracotherium*, fig. 2, I caused the matrix to be removed with great care from the bony palate, and believe that the posterior margin describes the notch extending as far forward as the interval between *m* 1 and *m* 2. A pair of canals open obliquely forward upon the bony palate opposite the same interval.

In *Miolophus* it appears that the bony palate extended backward beyond the molar series. But a more certain osteological difference from *Hyracotherium* is shown in the relative position of the anterior piers of the zygomatic arches, the posterior border being on the transverse parallel of the fore part of *m* 2 in *Miolophus*, fig. 1, whereas in *Hyracotherium* it is on that of the hind part of *m* 3, fig. 2.

The above-defined differences in the pattern of the grinding surface of the molar teeth are associated with a more triangular, or less quadrate, shape of that surface in *Miolophus*, and a minor degree of difference between the molars and premolars.

In *Lophiodon*, the grinding surface of the upper molars, *m* 1 and *m* 2 (Pl. X., fig. 5), has two outer lobes or cusps, *a*, *b*, connected with two inner lobes, *c*, *d*, by ridges proceeding from the fore part of the base of each outer lobe to the apex of each inner lobe, and inclining obliquely backward: the cingulum, *m*, girts the fore, inner, and hind part of the crown, subsides at the base of the antero-external lobe, *a*, and developes a small cone or cusp, *n*, at the antero-external angle.

In *Pliolophus* this pattern of grinding surface is manifest as follows:—the two outer lobes, fig. 4, *a*, *b*, are rather rounded than three-sided cones: the connecting ridges proceeding from the fore part of their base are low, save at their inner part, which rises into a small cone; they are chiefly represented by the three cones *e*, *f*; the two inner lobes, *c*, *d*, are rounded cones, more independent than in *Lophiodon*, by reason of the partial subsidence of the connecting ridges. The cingulum in *Pliolophus* closely corresponds with that of *Lophiodon* in the place of its interruption and of its chief development.

By the increase of the connecting ridges at the cost of the terminal lobes, the bilophodont type of tooth is acquired, as in *Tapirus* and *Dinotherium*. By the increase of the outer and inner pairs of lobes at the expense of their connecting ridges, the symmetrical quadricuspid crown of the Hippopotamus and Anthracothere results.

By the development of the basal connection between the two outer lobes, *a* and *b*, in *Lophiodon*, with retention of well-developed subtransverse ridges, *e*, *f*, the type of the *Rhinoceros's* tooth is reached.

The minor or partial modifications which give the characters respectively to *Palæotherium*, *Paloplotherium*, *Hipparion*, *Equus*, *Hyracotherium*, and *Pliolophus*, in the Perissodactyle series, and to *Anoplotherium*, *Hyopotamus*, *Chæropotamus*, *Sus*, and the *Ruminantia*, in the Artiodactyle series, are easily explicable after recognition of the modifications by which the leading types of Perissodactyle and Ardiodactyle dentitions have diverged from a more generalized ungulate type of grinding surface, such as is shown in the old Eocene Hyracotherioids.

DESCRIPTION OF PLATE X.

1. Palatal surface of upper jaw, *Miolophus planiceps*, nat. size.
2. — — — *Hyracotherium leporinum*, nat. size.
3. Grinding surface of *m* 2, left side, upper jaw, of *Miolophus planiceps*, magn.
4. — — — *Pliolophus vulpiceps*, magn.
5. — — — *Lophiodon medius*, nat. size.

II. ON TRACES OF GLACIAL DRIFT IN THE SHETLAND ISLANDS.

By CHARLES W. PEACH, of Wick, N.B.

HAVING last summer accepted the kind invitation of Mr. J. Gwyn Jeffreys to be his guest on a dredging expedition to these Northern Isles, I was induced, by a request from Sir R. I. Murchison, to look out for any trace of glacial action that I might meet with there. The result of my observations I have thought right to lay before the British Association, apologizing for the meagre story I have to tell. This poverty arises partly from my resolve to devote all time possible to the zoological work, and partly from having seen so small a portion of these islands.

Lerwick.—Our first landing was at Lerwick, where little time was spent either then, or when returning. In a short walk that I took in the immediate neighbourhood of the town, at the Bay of Sclate, I found the sandstone-rocks on the top of the cliff deeply rutted, striated, and polished; and a little inland, on the side of the famed Loch of Clickanim, others similarly marked. These markings are again to be seen on the opposite side of this bay. The ruts, &c., are all in a N. and S. direction, with slight deviations to the E. and W. The direction from which the drift came is evidently northerly, and may be traced up the valley, as shown by the widespread ruin, and the large blocks scattered over it, and resting on striated and polished rocks. The hills on each side of this valley, and those at the head beyond the docks, bear unmistakeable evidence also of polishing and grinding.

Out Skerries.—After leaving Lerwick, the Out Skerries of Whalsey became our home. The three small islands which form this group lie far out in the sea. They are called Gruna, Bruray, and Housay; there is an excellent harbour here, having two good entrances for vessels and boats, and a third into which boats can run when the tide answers. These entrances are triradiate, with the harbour in the centre, sheltered by the three islands from every wind.

The islands have been the scene of great grinding action, their surfaces being all more or less rounded, and bearing the *roches moutonnées* form of knolls, whether composed of granite, gneiss, quartz, or limestone,—these rocks being intermingled throughout the group. Although corroded by atmospheric action, and the limestone-portions much more affected by sea-water, the rounding can be everywhere seen. By these agents, ruts, striæ, &c., are thus generally obliterated; and although they are often further obscured by an overgrowth of lichens, I was fortunate enough to find newly bared rock near the Mill Cove, on the islands of Housay, from which I removed more of the drift and washed the stone; and here ruts, striæ, and polishing could be seen as plainly as if just done. I also found on a gneiss-rock in the highest part of this island some deep ruts and scratches, which, with those at the Mill Cove, ran E. and W., this being the direction of the channel of the two principal entrances to the harbour which separates Gruna from Bruray. The cliff on the north side of the Mill Cove of Housay is about 200 feet high; the sea breaks on the top of it in heavy gales and tears up the rock, and also throws up material from the deep. So great is the force, that large blocks are driven far back from the cliff into a large semicircular wall. Between this wall and the cliff a deep river-like gully is scooped, down which the water rushes again to the sea. The water left in the depressions in this gully is brackish, and in it *Enteromorpha* grows. Mr. Jeffreys and myself gathered portions of limpets, mussels, periwinkles, rock-whelks, and other sea-shells amongst the sand and gravel, both in and on the edge of the gully. The whole of the top of this cliff (much of it is now beyond the influence of the seas of the present day) is also strewn with proofs of similar action, some of the ridges of stones hanging on the rounded sides of the hill. All these loose blocks and stones rest on rounded knolls and polished rock, all so polished before the burthen they now bear was thrown on them. Although I know of many grand instances of such comparatively recent ruin, both in Caithness and Orkney, this far exceeds them all. Every season, the terrific seas which break on the whole of these islands leave tracks of their power of the most astonishing kind. Besides the markings on the rocks, I met with several deposits of drifted matter in which rounded and striated stones were not uncommon. Some of these deposits were from 12 to 14 feet in depth. Perched blocks—but not in abundance,—some of large size, were scattered over the whole group.

Unst.—Our next move was to North Unst, Balta Sound being our head-quarters. Here, too, glacial action was plainly to be seen. The serpentine rock has suffered seriously, and although much acted on by the weather, the rounded outline of the hills and knolls tells clearly of the grinding to which they had been subjected. Ruts and striæ, &c., are also rare here: they, however, occurred to me on the cliff at Haldale, in Haroldswick Bay, in a recently bared rock, underlying a thick deposit of drift, in which rounded and striated stones and blocks were plentiful. The whole of the serpentine enclosed in the drift shows the small pieces of chromate of iron it contains, standing up beyond the matrix, thus proving the rubbing, and that this mineral is very generally diffused throughout the whole of Unst. The direction of the ruts, &c., is nearly WNW. and ESE. The hills of the Muckle and Little Heogs lie to the north of this spot (Haldale), and a slope from about 20 feet above the level of the sea rises gradually hence to the top of the Muckle Heog, to the height of at least 500 feet. In this slope lies the famed chromate of iron quarry or mine. On reaching the top of this hill, I found the WNW. end vertical, and polished to the depth at least of 150 feet. The hill beyond slopes towards it. This *storm side* had evidently resisted a portion of the destroying force, and turned it on its western flank, and thus it swept down the valley towards Haroldswick Bay, as is evidenced by the greater destruction there than on the Eastern side towards Balta Sound. The scene from the top of the Muckle Heog, when looking towards Haroldswick, and then in the direction of Burrafiord, is one that tells of mighty agents, long continued, powerful to crush and grind;—so powerful, that the really hard and massive hills of serpentine have been ploughed down and removed to below the sea-level in places near Haroldswick. The sea has since piled up a beach on these spots, through which the water percolates from the low peaty soil at the back, at each recession of the tide. All over Unst the rocks show traces of abrasion; and in many places deposits of drift occur, enclosing stones of all sizes, some of which are rounded and striated. I mention a few of the places where I got drift, so that anyone desirous of seeing it may visit them. First, Haldale; at Hammer on Balta Sound; the Haunted Burn of Waltea, between Balta Sound and Ueay Sound, and at the latter place on the sea-shore. On the south side of the small island of Ueay, a similar deposit underlies a sandy raised beach, which encloses pebbles, whelks, oysters, and other sea-shells, with fish-bones in abundance. Large perched blocks—some many tons in weight—lie scattered about everywhere. In none of the glacial deposits did I find a single organism.

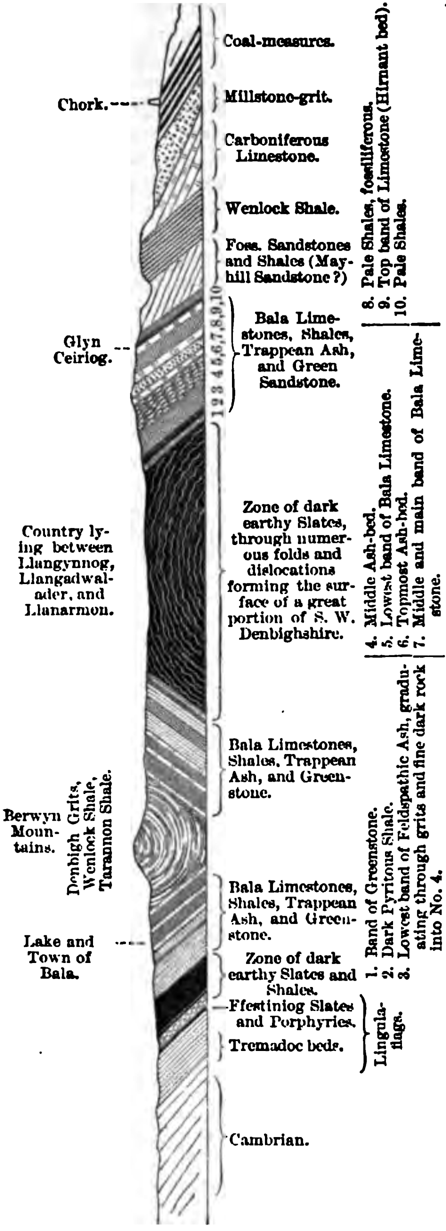
Thus, then, at both ends and the middle of this interesting group of islands, traces of glacial action were found. I must, however, leave the filling-up of the intervals to others. From the contour of the islands, seen as we coasted along them, the whole appear to have been subjected to similar agencies.

III. A Walk over the 'Ash-bed' and 'Bala Limestones' near Oswestry.

By D. C. Davies.

IT was a dull December morning (but my companion and myself are no mere 'parlour-geologists') when we were bound for the Limestones ar

Ceiriog, distant some eight or nine miles from Oswestry. After an early breakfast, we strapped on the munitions of war and looked well to the 'commissariat,' and, determined to make the most of the short daylight, we turned our backs upon the good old town of Oswestry.


Chork.
Glyn Ceiriog.
Country lying between Llangynnog, Llangadwaladr, and Llanarmon.
Berwyn Mountains.
Denbigh Grits, Wenlock Shale, Tarannon Shale.
Lake and Town of Bala.
Coal-measures.
Millstone-grit.
Carboniferous Limestone.
Wenlock Shale.
Foss. Sandstones and Shales (May-hill Sandstone?)
1 2 3 4 5,6,7,8,9,10
Bala Limestones, Shales, Trappean Ash, and Green Sandstone.
Zone of dark earthy Slates, through numerous folds and dislocations forming the surface of a great portion of S. W. Denbighshire.
Bala Limestones, Shales, Trappean Ash, and Greenstone.
Bala Limestones, Shales, Trappean Ash, and Greenstone.
Zone of dark earthy Slates and Shales.
Ffestiniog Slates and Porphyries.
Tremadoc beds.
Lingula-flags.
Cambrian.
8. Pale Shales, fossiliferous.
9. Top band of Limestone (Hirnant bed).
10. Pale Shales.
4. Middle Ash-bed.
5. Lowest band of Bala Limestone.
6. Topmost Ash-bed.
7. Middle and main band of Bala Limestone.
1. Band of Greenstone.
2. Dark Pyritous Shale.
3. Lowest band of Feldspathic Ash, graduating through grits and fine dark rock into No. 4.

Section illustrative of the general order through North Wales of the beds described in this paper *based upon* the sections of the Geological Survey, some details supplied by the Author.

Our route lay westward, up the slopes of the Coal-measures (here not worked) and of the Millstone-grit, to the racecourse of the town. From this point an extensive prospect is gained, embracing the plain of Shropshire, bounded on the east by the igneous hill of the Wrekin—on the south by the Brudden, of like plutonic origin, and the mining district of Shelve, backed by the Stiper Stones and the Corndon. Now we bent sharply round to the north, and passing the old earthwork of Offa's Dyke, here a considerable rampart, we crossed the Welsh border-band of Carboniferous Limestone, which is at this point extremely narrow, and then came at once upon a band of Feldspathic Ash, which runs up against the Limestone like a buttress. We followed the course of this Ash-bed for a mile or two, and then, near the lonely mountain-farm of Llechryddau, we made a halt to examine its structure and position.

Fortunately for us, though contrariwise for the miners who expected to find copper here, a level has been driven through the Ash-bed, along the whole course of which I once had an opportunity of examining the various layers composing it; and we were able to do the same thing again by means of the débris on the outside.

Here are fissured blocks of rapidly decomposing Feldspar, the parent beds of which may have furnished materials for some of the fine clays of the overlying formations. There are others made up of angular fragments of red and white Feldspar, set in a greenish paste, extremely hard: so large are some of the red fragments, that a miner once brought me a piece he had found in an ancient drift-bed overlying one of the Coal-seams as a proof of the existence in those days of men who knew how to burn bricks and pottery! In many of the fragments lying about, we saw how the coarser layers pass gradually into a finer texture of hard grey and green beds, in some of which are large crystals of sulphate of iron, embracing every variety of compactness, together with shaly and imperfect slaty cleavage; and if we were to follow the course of this Ash-bed two miles to the north, where it is thrown up into the ruggedly grand escarpment above Pontymeibon, we should see these various layers with their alternations and gradations *in situ*, and we should also observe how the whole series is traversed diagonally and perpendicularly by great veins of quartz. In accounting for the origin of Ash-beds such as this, some have supposed them to be made up of volcanic matter thrown up and deposited under water; but while we can conceive of a layer of limited extent geographically deposited in this way, the vast extent of country traversed by this and its neighbouring Ash-beds, their great thickness, and the preservation of their structural characteristics along their entire course, lead me to look with more favour to the theory which regards them as the 'recomposed' *detritus* of older igneous rocks, regularly deposited, and afterwards subjected to the consolidating influences of heat and pressure. The one we have been examining is the lowest of three Ash-beds which in North Wales underlie the Limestones, Sandstones, and Shales forming the variously designated Bala, Llandeilo, or Caradoc group of rocks; below it we find a dark-blue rock plentifully dotted with iron pyrites—then a thin band of Greenstone, a true igneous rock, and then a thick zone of dark earthy slates. Below this, in this part of North Wales, we cannot go, because the beds described in this paper, though rolling over in numerous bends and dislocations, keep to the surface and hide the inferior strata from view; but if we were to follow them northwards towards the lake and town of Bala, we should observe the dark Shales and Slates finally resting upon the Ffestiniog rocks, which in their turn conduct us down to the Tremadoc Slates and Lingula-flags. All this, by the way, as turning NE. from the farm-house, we made for Nant Iorweth—a dingle which opens into Glyn Ceiriog. Before long the loose blocks of Quartz and pale-green fragments of Ash which strew our path tell us we are crossing the second of the Ash-beds, which differs somewhat from the first in the preponderance of hard pale-green and greenish-white beds, together with dark grits. This band may be studied to advantage where the romantic glen of the Deiru joins the valley of the Ceiriog. Now in this glen of the Deiru, above the second Ash-bed, there occurs a thin bed of impure Limestone, which, though little known, is interesting as being, above the Lingula-flags, the first horizon of organic life. We were now four miles south of the spot where, in the débris of some old mines, it is to be seen; so we looked eagerly, as perchance we might meet with indications of its continuance southwards. Nor did we search in vain, for here were fragments which, from their position and texture, we identified as belonging to it, and in these, as we broke them up, we found its characteristic fossils. We were now at the top of the hill, and, had the day been clear, we should have seen before us one of the most charming valleys of Wales; but the December fog, like a thick curtain, hid it from our view. Blocks of quartz and boulders of trap told us we were now crossing the third and highest of the Ash-beds, and there, right before us, in the hill Fron Frys, rises up the middle and principal band of Bala Limestone, whose lowest beds form the slope of the hill we are descending; we were soon vigorously at work, cracking the stones which lie about the fields, and with but little regard, I fear, for the rights of property, played havoc with the dry stone fences, for here lurk the fossils, many nice examples of which soon found their way to our bags: but about these we must not gossip now, save to say that we looked hard for the *Ogygia Buchii*; for I believe, both from the fossils associated with it in South Wales, as well as from stratigraphical considerations with respect to the Shelve district in Shropshire, where it is also found, that this is the horizon where it should be sought if it is to be found in North Wales. Our search was in vain, though we knocked out plenty of its kindred genus, *Asaphus* (*Powisii*); but concerning *Ogygia*, so plentiful elsewhere, it must still be written 'not yet found in North Wales,' as well as 'does not occur in Ireland.' This is one of the curious examples of the apparently arbitrary distribution of species geographically which sometimes occur, and which serve to show that the age of any deposit is not to be determined solely by the presence or absence of any particular fossil. After a half-hour's rest, with refreshment by the fireside of a friendly cottage, we examined the lower beds of the Limestone *in situ*, and then journeyed slowly up the hill. I have described the peculiar features of the Bala Limestone elsewhere, so here I will only say that the lower beds are massive, they contain the usual ferruginous sandy layers, abounding with fossils, and then, on ascending to Cefn Coed quarry, their average thickness is reduced to five or six inches, and there they are interleaved with pale Shales. In these beds occur for the first time the beautiful Corals belonging to the genus *Heliolites*; and some nice examples of the Brachiopoda and other families occur, both in the solid Limestone and also in the Shales. It is interesting to notice how in the Shales the fossils are all more or less distorted, while in the Limestones they retain their original shape; just as if Shales and fossils were pressed out—elongated—in one direction, as the layers of consolidated Limestone slid down them, when this hill was tilted up into its present position. We were now at the summit of the hill; and, as the too short day faded into twilight, we looked up the 'reach' of the valley of the Ceiriog, which stretches from the New Inn to Pontymeibon, and could distinctly trace on the surface the rugged escarpments of the three 'Ash-beds' and the three Limestones, with the depressions between each, which serve to mark the place of the softer intervening Shales. This order of the strata may be taken as a type of this portion of the Bala or Llandeilo Group as it is developed in North Wales. In South Wales, where the Bala Limestone loses its distinctive features, the Trap-rocks also lose their massiveness; and the same is the case at Shelve, where the Ash-beds occur in numerous layers interstratified with flags and shales. We noticed the correspondence which each side of the valley bears to the other, Ash-bed, Limestone, and Shale answering each to each on either side, like Coleridge's 'Roland and Sir Leoline.'

> They stand aloof, the scars remaining.
> * * * * *
> Like cliffs which have been rent asunder;
> But neither time nor frost nor thunder
> Will wholly do away, I ween,
> The marks of that which once hath been.

This is not a mere valley of erosion; for in the dipping of the strata on the one side to the NE., and on the other to the SE., we at once perceive that it owes its origin to a crack in continuous strata, made in the process of upheaval, the said crack having been since widened by time and action of water, which weareth away the stones.

The day was closing, so we descended rapidly, past the kilns where the stone is burnt for lime, past the Shales overlying the Limestone, past the third or Hirnant Limestone, and, recruiting our strength at the New Inn, heavily ballasted with fossils, we wended our way up the steep hills of 'Wenlock Shale' which divide the valleys of the Ceiriog and the Dee. The lights of the town of Llangollen peered through the gloom as we gained the summit, and before long we were there. And now, kind reader, having brought you safely to a habitable and hospitable place, we thank you for your company, and bid you good-night.

ABSTRACTS OF BRITISH AND FOREIGN MEMOIRS.

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[The Report of this and the following Paper, read before the British Association at Bath, Sept. 1864, has been unavoidably postponed until this month.]

1. On the Boulder-clay of East Yorkshire. By J. Leckenby, F.G.S.

THE author pointed out the existence of the evidence of glacial conditions in the clays, sands, and gravels which overlie the Secondary strata of Yorkshire in its northern and eastern portions, especially around Whitby and Scarborough, in the Moorland Valleys, in the neighbourhood of Thirsk, and in the New Red Sandstone district near Ripon.

At Scarborough two well-marked divisions of these deposits were shown to obtain; the lower consisting of rolled and often firmly compacted gravels, in which were found fragments of the various granites of Scotland and Westmoreland, and of the hard blue Carboniferous Limestones of West Yorkshire. Blocks of granite of large size were not uncommonly found presenting scratched and grooved surfaces; but, probably owing to the softer nature of the Secondary strata of Yorkshire, no grooving or polishing of these rock-surfaces could be found.

Intercalated with these gravels are irregular beds of sand; and the whole are so arranged as to preclude the possibility of referring them to merely aqueous agency; the lines of demarcation being sharply defined, and the beds exhibiting distinct angles over which other materials are assorted.

The author described the upper division as composed of uniformly compact clay, with occasional seams of pure sand, well exhibited towards the northern point of Filey Bay near Scarborough, where numerous granite boulders with glacial markings existed *in situ.*

The entire thickness of the beds at Scarborough was stated to be not less than 200 feet, which was probably their maximum development.

The author collected the following shells in these glacial beds at Scarborough:—

Mytilus edulis.
Cyprina Islandica.
Venus lincta.
Astarte borealis.
Tellina Balthica.
T. calcarea.
Mya truncata, *var.* Uddevallensis.

Mr. J. Gwyn Jeffreys collected in the Boulder-clay at Whitby, besides those above numerated, the following:—

Astarte sulcata, *var.* elliptica.
Cardium edule.
Pholas crispata.
Balanus porcatus.
B. crenatus.
Lepralia.

Alluding to the absence of univalves, the smaller number of bivalves, and their more fragmentary characters, Mr. Leckenby pointed out the difference, in these respects, from the Caithness beds described by Mr. Peach before the Association in 1862, but which, from Mr. Peach's description, resembled in general features those of Yorkshire.

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2. ON CHANGES OF THE RELATIVE LEVEL OF LAND AND SEA IN SOUTH-EASTERN DEVONSHIRE, IN CONNECTION WITH THE ANTIQUITY OF MAN.

By W. PENGELLY, Esq., F.R.S., F.G.S.

FROM a careful examination of the geological evidences that can be studied relative to changes of level in Devonshire, Mr. Pengelly was led to recognize the following periods of change and their several results:—1st. A remote period prior to the lodgement of the gravels now occupying the valley-slopes and summits of the lesser hills of South-eastern Devonshire. In all other respects the physical characters of the district were as at present.—2nd. This was followed by a subsidence, the entire area ultimately becoming at least 300 feet lower than now. During this depression, marine gravels—not entirely of immediate, but never of very remote derivation—accumulated in the valleys until they were entirely obliterated; the summits of the hills were also covered, and similar materials were lodged in such fissures and crevices as traversed the rocks. Dartmoor existed as an archipelago, and was probably inhabited by the Dwarf-birch and Willows suitable to the Arctic or Sub-arctic climate which then prevailed.—3rd. A slow and uniform upheaval then brought up the entire district until it was no more than about 200 feet lower than at present. During this movement very much of the gravels previously deposited were stripped off.—4th. At this point the upward movement was intermitted, and no further change of relative level occurred for a very prolonged period. During this interval the breakers, by grinding down the outcrops of hard inclined beds of limestone, produced the extensive horizontal platforms of the Torbay district.—5th. To this succeeded a resumption of the slow and uniform elevatory movement. The limestone-terraces first emerged into dry land; the gravels were wholly or partially swept out of the valleys, but possibly, and at least in some cases probably, still more slowly than the district rose; small patches of it were left, or perhaps re-deposited, hére and there, on the hill-slopes as they rose above the sea-level, as, for example, on Windmill and Parkham Hills at Brixham, about 50 feet below the terraces just mentioned. Bovey Plain and the Brixham Cavern, each 50 feet lower still, at length became sub-aërial, and gradually the total elevation of the land produced by this second upheaval amounted to about 125 feet. *Betula nana* and the *Salices* probably took possession of the occasionally flooded Bovey Plain as soon as it was ready for their reception, which could not have been earlier than towards the close of this period; but the land was not yet high enough for the fluviatile introduction of the bone-bed of the cavern.—6th. Again the upward movement was suspended for a long time, and, during the pause, the breakers planed down the terrace represented by the Roundham-head Level.—7th. This achieved, the district once more began to rise, and when the Brixham Cavern had reached an elevation of not less than 40 feet above the sea, its bone-bed, with the multifarious articles found in it in 1858, might have been carried in; but, though it is apparently impossible to assign this event to an earlier period, there seems nothing to prevent its having belonged to a considerably later one. Whenever it took place, however, the bottoms of the adjacent valleys—whether of undisturbed gravel or of limestone rock—were not below the cavern-level; and at this height they must have remained during the very prolonged period represented by the deposit in question. This upheaval increased the elevation of the land by about 45 feet, or, in other words brought it up to within 30 feet of its present height.—8th. Once more the emergence was suspended, and in the pause were produced the well-known Raised Beaches. This period, however, distinctly divides itself into three: first, or earliest, that in which the waves cut, in the semi-crystalline limestone and almost vertical beds of the harder kinds of slate, a series of approximately horizontal shelves, some of which, notwithstanding their subsequent waste, are still upwards of 60 feet broad; secondly, that of the accumulation of the Beaches, which are made up of beds of gravel, succeeded at the higher levels by layers of fine sand, and in some cases terminated by what appears to be blown sand; and, thirdly, that in which the Beaches themselves were cut back into cliffs and shorn of much of their dimensions.—9th. Again the upward movement was resumed, and the entire district raised to an elevation of at least 40 feet greater than at present. Whether or not this was followed by an intermittence, there is no evidence to show; nor is it possible to say how long was the time before the newly emerged district was occupied with large trees. It is certain that during a vast period, either of rest or of continued elevation, it was covered with a forest, in which the Ox, Red-deer, Boar, Horse, and Mammoth found food and shelter, and the débris of which furnished them with graves.—10th. From the analogy furnished by the preceding phenomena, it seems highly improbable that an upward movement would be exchanged for a downward one without an intermediate pause. On this point, however, there appears to be no direct evidence. All that can be affirmed positively is, that after the Forest-era the entire district was carried down from whatever had been its previous height until the base of the forest-ground was not less than 40 feet below the sea-level.—11th. Assuming that the subsidence just mentioned was the last movement the district has experienced, we are in possession of facts pointing to the conclusion that the commencement of the period of quiescence which followed dates far back from the present day, down to which it has continued. No sooner have the sea and land acquired a new relative level than the former attacks the latter and produces a new line of cliffs with their concomitant platforms. Whatever was the maximum elevation obtained by the forest-area, an addition to that amount must be made to the existing heights of all the higher level-deposits: thus, for example, if the whole of Torbay to or beyond the five-fathom line was then dry land, the Raised Beaches, instead of 30, must have been 70 feet above the sea-level, and so on in all the other cases. As the works of Man remain in the Brixham Cave, which received its present contents at the time of the second upheaval, alluded to above, the human inhabitants of the area in question witnessed an Arctic flora in Devonshire, saw engulfed rivers carry into caverns osseous deposits, and, in times much less ancient, they may have collected Shell-fish on the old sea-beaches, now 30 feet above the reach of the highest tide, and hunted the Mammoth in a forest over which our largest ships of war now ride at anchor.

3. Les Eaux minérales du Massif central de la France, considérées dans leur rapports avec la Chimie et la Géologie. Par Henri Lecoq, Professeur à la Faculté des Sciences de Clermont, &c. Paris, 1864. Pp. 352.—(The Mineral Springs of the Central Plateau of France.)

THIS volume is a sequel to Professor Lecoq's general work on mineral springs, very recently published and already noticed in these pages.[*] It is an application of the principles there enunciated to the case of Central France, and is the first instalment of a work in preparation by its author on the geological epochs of Auvergne.

In the classification of the mineral waters of France, M. Lecoq, following M. Deville, adopts a mixed geographical and chemical division into five groups, each characterized by the presence of a class of salts. These groups are as follows:—1st. The waters of the Central Plateau of France, where the *bicarbonates* are present in the proportion of 75 per cent. These waters contain upwards of 300 grains of solid matter to the gallon.—2nd. The mineral springs of the Alps and Corsica, characterized by *sulphates* in the proportion of about 43 per cent., but not containing more than 170 grains to the gallon.—3rd. The springs of the Vosges, the Jura, and the hills of the Upper Saône. These contain 67 per cent. of *chlorides*, and 240 grains to the gallon.—4th. Those of the Ardennes and Hainault, characterized both by *bicarbonates* and *chlorides*. The first are in the ratio of 49 per cent., and the others 43. The solids are about 105 grains per gallon.—5th. The springs of the North-west Plateau, or Brittany, containing about 30 per cent. of *sulphates*, 38 per cent. of *bicarbonates*, and 23 per cent. of *chlorides*; but the whole solid contents are not more than 40 grains per gallon.

Locally M. Lecoq establishes fifteen groups of springs—seven in the department of Puy-de-Dôme, the rest in adjacent departments. The former are the more generally known, and the more interesting in a geological sense. Of its seven groups, that of Mont Dore is the first considered. Mont Dore consists of a mass of volcanic rock, nearly 3,000 feet thick in places, and situated on a granitic plateau.[†] Fissures have been formed in this erupted mass after cooling dislocations have taken place, and mineral springs rise in the long valleys of Mont Dore and Chaudefour, radiating from the centre of the mountain-group. In the Mont-Dore Valley (Dordogne) are several groups issuing from trachyte. In the Chaudefour they are from crevices in the granite.

In the upper part of the valley of the Dordogne is the spring called *la Cheminée du Diable* (the Devil's Chimney). It is situated at the foot of the Pic de Sancy, and is not very accessible. It is singular to see a deposit of iron and limestone amidst trachyte. The minerals have been left behind by the spring, which is now small and cold. M. Lecoq believes that the carbonate of lime comes in this case from beneath the granite underlying the trachyte. Several adjacent springs are ferruginous.

The *Mont-Dore* springs may be regarded as seven in number, but each includes a small group. Their temperature varies from 108°

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[*] See Geol. Mag., Vol. II. pp. 115 and 164.

[†] The highest point of the Pic de Sancy is 6,130 feet above the sea.

F. to 113° F. Some yield very small quantities of water, and their total yield is about 48 gallons per minute. The water issues clear, and slightly acidulous, and becomes cloudy on exposure to the air. Carbonic acid gas is emitted with the water, the quantity varying with the weather and in the different springs. One spring much colder than the rest yields a much larger quantity of gas than the others. Nitrogen and a little oxygen are also given off. The composition of the waters is very complex, including bicarbonate of soda, potash, lime, lithia, magnesia, manganese, protoxide of iron, rubidium, and cæsium;* chloride, iodide, and fluoride of sodium; sulphate, arseniate, and borate of soda; silica, alumina, and a trace of bituminous organic matter.

M. Lecoq, with good reason, attaches much importance to the mineral deposits in the neighbourhood of springs. In those of Mont Dore he finds traces of iodine; and Berthier has alluded to phosphorus and fluorine. A considerable mass of resinous quartz was destroyed in building the thermal establishment. It contained silicified wood. It is thought that the quantity of silica in the water diminishes.

A tufaceous deposit on the banks of the Dordogne, about 1¼ mile below Mont Dore, marks the springs of the *Compissade.* They are three in number, issuing from trachyte, and flowing over travertin. Two are cold, and one is warm, the latter depositing silica. About 2¾ miles beyond, out of fissures in granite and trachytic tufa, rise the springs of *La Bourboule.* They are seven in number, yielding about six gallons per minute, the temperature high but variable, sometimes nearly 130° F. They yield chiefly common salt and bicarbonate of soda. They also show traces of the chlorides of lithium and the new metals, phosphate and arseniate of soda, iodide and bromide of sodium. A slight odour of sulphuretted hydrogen is noticed at the springs, and they have a distinctly acid and salt taste.

In the valley of Chaudefour are a number of small mineral springs, some warm and some cold. They are for the most part chalybeate. They yield, on the whole, about 60 gallons per minute. The new metals have not been detected in them; but they contain iodine, bromine, arsenic, phosphorus, and a calculable percentage of sulphate of strontia. All yield carbonic acid gas. A large deposit of carbonate of lime is obtained from the waters of St. Nectaire, and advantage is taken of this in the manufacture of natural cameos resembling those of Tuscany.

In traversing the granite, these mineral waters change and decompose the felspar, and cause the rock to disintegrate, while occasionally crystals of arragonite are deposited in the crevices and fissures of the rock.

The second division of the mineral springs of the district includes a number of outlying groups. Of those on the banks of the Allier, one (*Saut du Loup*) is intermittent; others (*Nonette, Coudes*) rise through large masses of travertin; another (*Tambour*, the Drum) issues with a rumbling noise; others (*St. Mar-*

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* It is from the mother-water derived from evaporating 200 litres (17 gallons) of water, that these metals and lithia have been determined.

guerite) are warm (90° F.), and contain much carbonate of lime, with bicarbonate of soda, common salt, and various other salts, to the extent of 600 grains to the gallon. One of the number (*St. Martial*) yields as much as 470 grains of salt to the gallon, and rises through a mass of travertin 2,000 feet in diameter, and nearly 7 feet thick. More than one human skeleton has been found in this mass. This is the more remarkable, as these waters now deposit but little carbonate of lime. The celebrated springs of Vichy belong to this group. They are situated in an alluvial basin in Tertiary deposits of small thickness, resting on Primary rocks. The whole is permeated by the mineral waters which probably issue from the granite. Springs have been obtained from artificial borings, in addition to those that rise from natural crevices. There are now thirteen natural springs and three borings. The temperature is exceedingly variable (from 54° to 111° F.). The volume of water issuing is also variable, but the total is not estimated at more than 65 gallons per minute. Some of the springs are intermittent. Carbonic acid gas issues from the water of some of the springs with great violence, but this is somewhat marked by a peculiar and rather bituminous odour derived from organic matter. Nearly 500 grains of carbonic acid by weight are contained in a gallon of Vichy water from some of the springs, and about 300 grains of solid bases. Of free carbonic acid gas there are from 70 to 200 grains per gallon. There are bicarbonates of soda (in large quantity), potash, magnesia, strontian, lime, protoxide of iron, and protoxide of manganese ; sulphate, phosphate, arseniate and borate of soda ; chloride of sodium, and silica. Traces of lithia, iodine, and bromine have also been recognized. The quantity of carbonic acid issuing from these waters of Vichy is so large, as to suggest to M. Lecoq the presence of large deposits of carbon or of solid carbonic acid in the interior of the earth. The albuminous matter present is also very remarkable, as it presents analogies with the vegetable kingdom in its green colour, and with the animal kingdom in its nature. On exposure it becomes fetid, but does not yield animalcules. The quantity of soluble bicarbonate of soda that issues from the Vichy springs and runs away into the Allier, and so to the ocean, amounts to nearly 1,400 tons per annum. The quantity of insoluble matter is much smaller (amounting to about 100 tons per annum). This has formed a deposit in the Vichy basin estimated to amount to not less than 3,000,000 tons. At the present rate of deposit, it would take upwards of 30,000 years to form such a mass. This is a long period for contemporary deposits. All the Vichy waters, however, tend to choke up their outlets, and the issue of the water may formerly have been much larger than it is now.

Near Clermont are some remarkable springs. Those of Royat, three in number, pass through Tertiary sandstones and travertins. Their temperature varies from 86° to 95° F. They yield much nitrogen. They contain chiefly the bicarbonates of soda, lime, magnesia, and potash, and common salt, but also sulphate, phosphate and arseniate of soda, and chloride, iodide, and bromide of sodium

The deposits choking up the issue of the water are very extensive, and of great thickness.

Most of the Clermont springs rise to the west and north-west of the town. They are sixteen in number, and compose four groups. Some are artificial borings. One group—that of St. Alyr—is remarkable for the beautiful incrustations produced by its waters. All have deposited enormous quantities of travertin. A natural bridge and aqueduct of travertin, nearly 300 feet in total length and 16 feet wide, is an interesting example of the nature of this deposit. It has been about four centuries in forming. The St. Alyr deposits are interesting in a mineralogical sense, owing partly to their condition, and partly to the banded structure of the carbonate of lime, more or less coloured by iron oxide. There is also a curious rock, consisting of a very hard conglomerate with a calcareous cement, combining an infinity of minute water-worn grains and pebbles of quartz, pozzuolana, fragments of basalt, and scoriæ. The composition of the older travertin seems different from that of the modern deposits. The former yields the following analysis :—

Water	0·800
Carbonate of lime	40·224
Carbonate of magnesia	26·860
Carbonate of strontian	0·043
Peroxide of iron	6·200
Sulphate of lime	5·382
Sub-phosphate of alumina	4·096
Phosphate of manganese	0·400
Crenate and apocrenate of iron	5·000
Organic matter not nitrogenized	1·200
Silica	9·780
Loss	0·015
	100·000

The more modern rock gives only a trace of carbonate of strontia, 32 per cent. of carbonate of lime, and 9 per cent. of sulphate of lime.

Besides these there are many other springs in the valley of the Limagne, generally issuing from minute transverse fissures in the granite. The total quantity of water is large, but most of the separate springs are very small. Arsenic has been detected in them. Bromine and iodine, phosphorus and strontian, have also been found. There are considerable masses of travertin in their immediate vicinity.

On the banks of the Sioule there are numerous groups of springs, of which those of Châteauneuf are the most important. Some are cold, and several are warm. Neutral bicarbonates are the chief contents. The waters being immediately mixed with those of the river, there is no opportunity of forming deposits.

A number of other springs are described by M. Lecoq in various parts of the Puy-de-Dôme. Some few are sulphurous, but most of them yield large quantities of carbonic acid gas and sub-carbonates. The *Puy de la Poix* yields a considerable quantity of bitumen, especially in winter. It is estimated that at least 150 kilomètres of this substance is thrown out with the water every year, and being indestructible, it accumulates in little hillocks. It has been remarked that bitumen is common in the schists of Auvergne.

In the department of Cantal there are no less than 103 mineral springs, 83 issuing from granite and other crystalline metamorphic rocks, and 16 from volcanic rocks. They chiefly emerge in valleys. Of some of these the temperature is very high, but not constant. The Chaudesaigues springs, for example, not only vary from time to time, but seem permanently hotter now than formerly. The spring of *Par* in 1771 was described as having a temperature of 167° F.; and in 1828, 177½ F. Others are lower, but all are very hot. The quantity of water issuing is large, and the whole neighbourhood around feels the effect. The hot water is used for various economical purposes, amongst others for warming the houses. It is calculated that the quantity of heat liberated each day by these waters is equivalent to the consumption of about six tons of coal. Although so hot, the waters of Chaudesaigues are not rich in salts and other minerals.

While the springs of *Par* have increased in temperature since 1788, those of *Néris* on the Allier have greatly cooled. The spring *Grand-Puits* has lowered from 172° F. to 126½ F., and the *Puits de la Croix* from 167° F. to 125° F.; the lowering not having been gradual, but by jumps. The great earthquake of Lisbon (1775) produced very marked effects on this spring. In solid contents the Neris water is not remarkable, but it is unusually rich in organic matter, and a peculiar growth of *Confervæ* takes place very rapidly after the water reaches the surface.

We have given this very brief abstract of the contents of M. Lecoq's very elaborate volume, in order that our readers may form some notion of the extent of material accumulated. Nearly 300 springs are described, and some account given of each, including in most cases the volume of water, the temperature, and the contents as determined by analysis. It would be unfair not to recognize the great labour and care that have been taken, though one would have been glad of some general *résumé* rendering the facts more generally manageable. M. Lecoq bears constantly in mind his theory of the origin of mineral springs; but this does not prevent him from putting forward honestly the whole of the evidence that exists in the case of the springs he professes to describe. His work must always be valuable as a book of reference.—D. T. A.

REVIEWS.

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1. THE WATER-SUPPLY OF THE PERMIAN ROCKS OF DURHAM.*

ON THE MAGNESIAN LIMESTONE OF DURHAM. By MESSRS. DAGLISH and FORSTER. British Assoc. Report, 1863, p. 726.

Water-supply.—The hydrology of the Magnesian Limestone and the Red Sandstone beneath it is first discussed; and there are few formations in British geology the water-bearing properties of which are so remarkable. Previous to 1818, when the Durham Coal-measures were wrought only to the west of the Magnesian Limestone, the quantity of water in that rock and the underlying 'Lower Red Sandstone' does not seem to have been suspected; but in the first attempt to win coal below the limestone, near Hetton-le-Hole, such immense bodies of water were encountered on reaching the 'Lower Red Sandstone,' that the shaft had to be abandoned. The skill of the northern engineers, of course, ultimately prevailed, both here, and where other pits were subsequently put down, but only after severe struggles,—a first and second shaft having sometimes to be given up as failures before the Coal-measures could be reached; and 1,000, 2,000, and even 10,000 gallons of water a minute had sometimes to be pumped from the shafts in order that the sinkers might work.

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* See GEOLOGICAL MAGAZINE, Vol. II. p. 29.

But what is so great an evil and such a source of expense to the coal-owner has been turned to a great good, and a source of wealth, to the inhabitants and capitalists of the district; for, availing themselves of the knowledge so dearly bought by the former, the latter have sunk deep wells to these subterranean reservoirs, and so obtained a plentiful supply of pure water. The towns of Sunderland, South Shields, Jarrow, and Seaham, besides numerous villages, are all furnished with water in this manner. The aggregate supply at these places, combined with the quantity taken from the same sources by private wells, is probably at the present time very little under 5,000,000 gallons daily.

The water is usually met with in the form of powerful feeders;—a feeder being a joint or fissure filled with water. Messrs. Daglish and Forster suppose that a very slight supply is derived from the percolation of water through the mass of the rock itself; and this undoubtedly holds good, as the question is practically viewed by them. But there is just as little doubt that water percolates more or less the whole mass of the Magnesian Limestone and the underlying Sandstone, and that below the water-level these deposits are kept thoroughly saturated according to their capacities of saturation. The capacity of these rocks for retaining water varies. Some of the crystalline varieties of the limestone absorb very little. Others, less crystalline in character, hold 3·45, 6·0, 13·13, 14·87, and even 17·0 lbs. of water to the cubic foot. The sandstone varies less in this respect; 10 lbs. of water (or a gallon) to the cubic foot being about its usual point of saturation. With the lower strata of the limestone and the sandstone thus saturated, all cavities and empty spaces in their mass naturally become filled with water. Open joints and fissures, of which there are many, more especially serve as receptacles for it; and from their wide ramifications they form great subterranean reservoirs ready for the use of man—or for his annoyance, as the case may be. They, moreover, not only serve as natural reservoirs, but also, from the extensive areas offered by their walls as surfaces of collection, as a means for the rapid accumulation of supplies from the main stores of water held in the mass of the rock.

Near the sea, the level of the water in the Magnesian Limestone agrees, as usual, with the level of the sea. Farther inland the saturation-line rises, until, at a distance of four miles from the coast, it reaches a point of 180 feet above sea-level. A slight variation in the level is also to be observed near the outcrop of the limestone and underlying sandstone in different seasons of the year or states of the weather.

As the area of distribution of the water-bearing strata of the district in question is comparatively limited, being little more than fifty square miles, it becomes a question of some importance whether it can long sustain a demand so large without showing indications of its powers being overtaxed. There does not appear, however, any reason for supposing that the demand as yet exceeds the power of supply; for the water-level has not fallen in the least, it being the same now in wells made fifteen years ago as when they were first sunk; but whether the demand could be much increased without exceeding the supply, is a point as yet unproved. If the chief source of the supply is the rainfall on the Magnesian Limestone plateau, as we believe it to be—assisted perhaps, as suggested by the authors, by the leakage of brooks and rivers,—it is doubtful whether any great addition to the present demand would not attain or exceed the maximum of the supply. Such an event would, of course, very soon indicate itself on the land-side of the plateau by a falling of the water-level; while along the sea-board, where the water-level is coincident with the mean level of the sea, it would most likely first be made evident by the wells becoming brackish from the infiltration of salt water.

After the Permian rocks are pierced and the Coal-measures fairly entered, very little fresh water is met with. The authors point out that in the deep pits near the sea-coast, the water, below a certain depth, is invariably saline, though not in an equal degree,—the salinity increasing with the depth, until the water attains the specific gravity of the sea. In other parts of the Coal-field, as at Lambton, Birtley, Walker, Framwellgate, &c., saline springs occur, occasionally coming to the surface; and some have been used for the manufacture of salt. These the authors are disposed to look upon as entirely different in character from those first mentioned.

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2. VOGT ON THE ANTIQUITY OF MAN.

LECTURES ON MAN; HIS PLACE IN CREATION, AND IN THE HISTORY OF THE EARTH. By Dr. CARL VOGT, Prof. Nat. Hist. Univ. Geneva. Edited by JAMES HUNT, Ph. D., F.S.A., F.R.S.L.—London: Longmans (for the Anthropological Society). 8vo. Pp. 475, with 130 Illustrations.

AN English version of one of the most important works bearing on the History and Antiquity of Early Man which has yet been issued on the Continent is now before us, and we hasten to lay before the readers of the GEOLOGICAL MAGAZINE some of the subjects in which the author touches on the various points connected with 'Tertiary' Geology. We may remark, that the greatest portion of the work is devoted to the discussion of topics relating to the questions of modern anthropology, in which the author, with great boldness, advocates the theory of man's descent from several species of fossil ape. Most of the points which bear on the early history of man, and on his relations with the lower animals, are discussed in detail. Many passages of this otherwise learned work reflect a spirit which is very painful to witness in the writings of a student of inductive science. Our author delights throughout the work, on every occasion in which a triumphant argument can be clinched by him, and at the more frequent times when the concealment of his own scientific error becomes imperatively necessary, to adopt a style of argument which chiefly consists in the employment of an ironical jeer, or a harsh expression, against those scientific men whose opinions may differ from his own. We regret to see this tone pervading the whole of Prof. Vogt's work, whilst we admit that his writings justify the assertion, that there is no one in the world so illiberal as the advocate of self-called 'liberal' scientific opinions.

The tenth and eleventh chapters are those which are especially devoted to the evidences of early man from the drift- and cave-deposits. It is to the eleventh chapter that we shall particularly direct our readers' attention. The author commences by avowing that, like most geologists of the past generation, he was an advocate of the theory of successive creations of various animals, which were destroyed one after the other, by periodical cataclysms. The further investigations into which he was led, however, induced him to abandon the opinions of his youth, and to admit that infinitely long periods of time, coupled with the influence of apparently small forces, have gradually produced the changes of the world's life-scene. Having, like many others, thus developed from a catastrophist into a uniformitarian, Prof. Vogt applies the latter mode of reasoning to the investigation of the Diluvial epoch of Europe.

He considers that the climate at the end of the Tertiary period was probably warmer than at the present day. The discovery of human remains in the Tertiary strata, in accordance with the views of M. Desnoyers, is considered by Vogt as highly probable, as there are no sufficient reasons against the assumption that man 'may' (*sic*) 'have lived in the Tertiary period in countries inhabited by elephants, rhinoceroses, oxen, horses, and apes. Generally speaking, however, man has only appeared in Europe and North America during the so-called Diluvial, Post-pliocene, or Quaternary period. The word 'Post-tertiary' is never employed by Vogt. This period, however, being demonstrably proved to be one of extreme cold, is contrasted with the one immediately preceding it, and the question propounded for solution—Did Man exist in France, Belgium, and England before or after this Glacial period? The chief interest in the supposition rests on the assumption, that if Man had existed prior to this great event, the Glacial period may have put a stop to his existence in these countries. He then reviews the stratigraphical evidence. Taking the glacial loam, or Boulder-clay, as it exists in Scandinavia, North America, England, and the Alps, as a starting-point, we find few deposits which lie below it, and which are subsequent to the deposition of the Tertiary beds. The crag-deposits of England and the forest-bed of Cromer are given as examples, and great stress is laid by Vogt on the presence of recent species of Mammalia, and of plants identical with those found in post-glacial deposits in the forest-bed.

In Switzerland we have lowest of all the glacial loam, there consisting of a more or less grey or bluish unstratified clay, containing boulders. The large angular erratics of the Jura, at a height of 1,600 mètres above the sea, have been deposited by the same action as the loam, and both form the limit of the greatest expansion of the Swiss glaciers. Above this glacial clay there exist considerable beds of pebbles, gravel, and sand, firmly cemented together by the infiltration of lime. Some of these pebbles are as large as a man's head, and none exhibit grooves or striæ: they are merely rounded by the action of water. These could only have been deposited after the retreat of the glaciers towards the Alps. Prof. Vogt considers that the retreat of these glaciers must have been a very complicated phenomenon, as the general features of the country existed then as at present. He denies the theory that the glaciers, at the period of their greatest extent, scooped out valleys and lake-basins in the soft Molasse, and considers that the glaciers remained for a long period in the valleys and basins, from which they sent forth branches between the molasse-hills already free from ice. Traces of this action are seen in numerous terminal moraines, which testify to the preservation of the glaciers in the lake-basins and deeper valleys. A further retreat took place after the stoppage, which is indicated by the numerous moraines which correspond with the alluvial terraces on the plains. Each of these stoppages may have continued for a long time; but throughout the whole period during which the glaciers retired, the formation of glacial clay, alluvium, rolled pebbles, and the transportation of boulders, continued without interruption. He quotes the authority of Desor in favour of this theory, and against that adopted by Morlot, Collomb, and many English authors. Admitting the fact that the old alluvium everywhere overlies the boulder-clay, he considers it to be equally without doubt, that above this old alluvium lie angular blocks intermingled with glacial clay and recent alluvium. He points out that the stratification of the terminal moraines above and below the old alluvium is nowhere demonstrated, and assumes that those blocks which rest upon the old alluvium have not been transported by glaciers, but by ice-blocks. A glacier of several thousand feet in thickness would have scooped the soil rather deep, whilst the extremity of a glacier scarcely 100 feet thick might pass over a gravelly soil without digging deeply therein. The lignite-beds and peat-bogs of Switzerland are referred to as examples of deposits which have been overwhelmed and compressed by enormous masses of drift. It is probable that at least before the commencement of the Glacial period, if not immediately after it, England, the North of Europe, Denmark, and Norway were connected, whilst large districts to the east were under water. When the northern cold increased, the northern population retreated southward, as is shown by the shells found in the German Ocean and the Baltic. When the cold became less intense, it returned towards the north. Such physical changes, producing immigrations and emigrations, require much time: only a long series of centuries, the number of which can scarcely be estimated, could have been sufficient. He gives a minute description of the coal-beds of Eastern Switzerland, some of which Prof. Heer estimates to have required a period of 9,600 years for their deposition. They contain freshwater snails of living species, the elytra of small marsh-beetles, and remains of *Elephas antiquus* and *Rhinoceros leptorhinus.* These coal-beds were formed upon the glacial clay immediately after the retreat of the glaciers; they were then covered by the alluvium: whence he draws the consequence that the beds in which *Elephas primigenius* and *Rhinoceros tichorhinus* occur are somewhat later than the slate-coal beds.

Greenland, a continent not less in extent than the whole Scandinavian peninsula, is covered with an ice-crust 1,000 feet thick, moving from the interior towards the west coast. It there breaks up to form the icebergs which cover the Northern Atlantic, ultimately melt, and leave their freight on the bottom of the sea. He considers that the same occurred in Norway, Sweden, and Finland, where the sea gradually rose, the land became warmer, the ice-shroud melted, and the ice was left in the valleys, between the pinnacles of land that then showed themselves. The sea rose about 500 feet, as we find up to this height deposits of extinct Arctic mollusca. The melting ice produced large streams, which formed lakes, and deposited the finer materials transported by them, as loam, marl, and sand-clay. Erratic blocks were brought down by the glaciers, and these were deposited on the banks. This theory is supported by the researches of Kjerulf, Sars, and Lovén; and analogous phenomena are exhibited in England, Switzerland, North America, and elsewhere. Prof. Vogt is led to the inference that the Diluvial period lasted an incalculably long time, during which there was much elevation and subsidence in land and sea, and many mutations of species of plants and animals.

We copy the table on opposite page from Professor Vogt's work.

That Man appeared in our hemisphere only in the course of the Diluvial period, Prof. Vogt considers to be an admitted fact. Whether, however, he appeared before or after the last glacial extension on our continent, is still an open question. After careful examination, Prof. Vogt arrives at the opinion that the apparition of Man in Europe is posterior in date to that of the formation of the Boulder-clay. He is willing to accept a higher antiquity of Man, should his remains be hereafter found either under the glacial clay, or under undisturbed Tertiary beds. He approves strongly the calculations of Dr. Bennet Dowler, according to which the age of the delta of the Mississippi Valley is estimated at 57,500 years, and quotes the discovery of burnt brick and pottery at the foot of the statue of Rameses as a proof of the high antiquity of certain Nile deposits. English geologists, who have already had frequent oppor-

Scandinavia.	Great Britain.	Belgium, North Germany.	Valleys of the Seine, Somme, Yonne, &c.	Vosges.	Rhine-valley and South Germany.	Switzerland.
Kitchen refuse (Kjökken-möddings). Older Pine Period of the turf-moors.	Loam.	Modern alluvium. Loam. Mecklenburg graves ?	Caves of Lombrive with Man, Aurochs, Rein-deer, &c. *Diluvium rouge.* Loess and clay of Paris, Amiens, Abbeville, &c.			Loam and modern alluvia.
Upper moraines in the valleys. Pebbles in the lower valleys. **Osars.**	Sand, with freshwater snails—*Elephas primigenius*, *Rhinoceros tichorhinus*. Stone hatchets, near Hoxne, Icklingham, on the Ouse. Caves, with *Ursus spelæus*, *Hyæna spelæa*, and hatchets.	Caves of Liège with *Elephas primigenius*, *Rhinoceros tichorhinus*, *Ursus spelæus*, &c. Man of Engis, Engihoul, and Neanderthal.	*Diluvium gris* with *Eleph. primigenius*, *Rhin. tichorhinus*, Man of Amiens, Abbeville, Paris, &c. Caves with *Ursus spelæus*, *Hyæna spelæa*, &c.	Terminal moraines in the valleys.	Loess and loam of the Rhine-valley, of the Necker-valley, with *E. primigenius*, *R. tichorhinus*, &c. Terminal moraines in the Black Forest.	Stratified diluvium with *Elephas primigenius*, *Rhinoceros tichorhinus*, &c. Older alluvium. Terminal moraines near Zürich, Sempach, Bern, Geneva, &c.
Greatest height of the Ice-sea. Bed with glacial molluscs.	Clay, with wood (oaks, yew, pine), near Hoxne. Old alluvium (drift), with pebbles. Clays, with glacial molluscs, on the Clyde.	Blocks of the North-German plain transported from Scandinavia.	Diluvium of the plateaux.	Vosges-gravel.	Vosges- and Black-Forest gravel.	Slate-coal with *Elephas antiquus*, *Rhinoceros leptorhinus*, near Dürnton, Utznach, Mörshwyl.
Glacial tracts beneath the present sea-level, with scored stones	Glacial clay with blocks (Boulder-clay).			Alpine gravel.	Gravel of the Bavarian plateau.	Glacial clay and marl with blocks and scored stones. Erratic blocks on the Jura.
	Cromer forest-bed, with *Elephas antiquus* and *meridionalis*, *Rhinoceros etruscus*, &c.					

tunities of criticizing these alleged discoveries in detail, will probably not coincide with Prof. Vogt in the high value he appears to place on them. The discoveries in peat-bogs are also commented on by him in a whole chapter. We are not, however, aware that any new fact is therein presented with which English Geologists are not well acquainted; and the same observation applies to the chapters on the Stone-period of the North, and the Swiss *Pfahlbauten*.

We have endeavoured to place the opinions and facts of Prof. Vogt before our readers in a lucid form, and without any remarks of our own. It is more than probable that they will produce the same amount of controversial criticism in England that they have in Germany. The eleventh chapter, however, is unquestionably the best in the book, as it is free from the frequent slips of expression and carelessness to recorded facts which stud the ninth, tenth, and twelfth chapters.

We cannot close this notice without a tribute of praise to the editor, Dr. Hunt, who has laid this readable and elegant volume before the British public. It might have been wished that he had added a few more notes to elucidate the meaning of his author, and had rectified a few more of the errors of the German edition; but, taking the book as it is, we have no doubt that it will give great pleasure to all those who investigate the geological proofs of the Antiquity of Man.

REPORTS AND PROCEEDINGS.

Geological Society of London.—I. May 24, 1865.*—Dr. E. Meryon, Vice-President, in the Chair. The following communications were read:—

1. 'Additional Observations on the Raised Beach of Sangatte, with reference to the date of the English Channel, and the presence of Loess in the Cliff-section.' By Joseph Prestwich, Esq., F.R.S., Treas. G.S.—In this paper on the Loess and Quaternary beds of the North of France and South-east of England, Mr. Prestwich expressed an opinion that the break in the land between France and England was not the result of the last geological change, but that the channel existed at the period of the formation of the Low-level gravels of the Somme and Thames Valleys, and probably at that of the High-level gravels. During a recent visit to the Sangatte Raised Beach, the author recognized fragments of chert in the shingle and associated sands, which he inferred were derived from the Lower Cretaceous strata; associated with them were fragments from the Oolitic series of the Boulonnais and two pebbles of red granite, probably from the Cotentin. These facts seemed to the author to add much probability to the existence of a channel open to the westward, and extending between France and England, anterior to the Low- and possibly to the High-level Valley-gravel period. Above the raised beach occurs a

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* The report of this meeting was inadvertently omitted from our last number.

mass of chalk- and flint-rubble, with beds of loam, from 20 to 80 feet thick, and containing Land-shells. Mr. Prestwich considered this accumulation analogous to the Loess, which it resembles in general character, while the shells found in it belong to species common in that deposit.

2. 'On the Superficial Deposits of the Valley of the Medway, with Remarks on the Denudation of the Weald.' By C. Le Neve Foster, Esq., B.A., B.Sc., F.G.S., and William Topley, Esq., F.G.S., of the Geological Survey of Great Britain.—In the first part of the paper the authors gave a description of the superficial deposits of the valley of the Medway. They showed that deposits of river-gravel and brick-earth (loess) occur at various heights up to 300 feet above the level of the river. A detailed account was given of the 'pipes' at Maidstone, where brick-earth (loess), containing land and freshwater shells and mammalian remains, has been let down into deep cavities in the Kentish Rag, probably by the gradual dissolving away of the limestone by the action of rain-water containing carbonic acid. Several interesting cases of disturbed gravel were mentioned. The second part of the paper was intended mainly to show what light is thrown upon the theory of the denudation of the Weald by a study of the superficial deposits. After a brief account of previous theories, with objections to the theory of fracture and the marine theory, the authors endeavoured to prove that the gravel and brick-earth (loess) occurring at a very great height above the level of the Medway are old alluvia of that river. If this point be granted, it follows that so large a denudation has been effected by atmospheric agencies—*i. e.*, rain and rivers,—that, in the opinion of the authors, there will be little difficulty in supposing the present inequalities of surface in the Weald to have been produced by these agents acting on a comparatively plane surface of marine denudation. A discussion as to the origin of Escarpments then follows. The authors considered that the Escarpments of the Chalk and Lower Greensand which surround the Weald are not sea-cliffs, but are due to the difference of waste of the hard and soft formations under atmospheric denudation.

II. June 21, 1865.—W. J. Hamilton, Esq., President, in the chair. The following communications were read :—

1. 'On the Carboniferous Rocks of the Valley of Kashmere.' By Capt. H. Godwin-Austen. With Notes on the Carboniferous Brachiopoda, by T. Davidson, Esq., F.R.S., F.G.S. ; and an Introduction and Résumé, by R. A. C. Godwin-Austen, Esq., F.R.S., F.G.S. Communicated by R. A. C. Godwin-Austen, Esq., F.R.S., F.G.S.—This paper was a continuation of one read before the Society last year, in which the Carboniferous, Jurassic, and Post-tertiary deposits and fossils were described by Capt. Godwin-Austen, Mr. Davidson, and Mr. Etheridge. In this communication Capt. Godwin-Austen confined himself to the Carboniferous formation, which was shown by him to have, in the Valley of Kashmere, a thickness of more than 1,500 feet. The upper portion of this mass contained but few fossils,

except in one particular bed near the entrance of the ravine above the village of Khoonmoo; but the lowest portion, or Zèwan bed, is made up chiefly of the remains of Brachiopoda and Bryozoa; and a higher stage, though still near the base of the formation, contains abundant remains of *Producta.* The position of a limestone containing *Goniatites* is not very clearly determined, but it is probably a member of the Zèwan series.

The sections in which the relative positions of the different beds were exhibited were described in detail, and plans and a map were given showing their geographical relation.

Mr. Davidson described the Brachiopoda forwarded with the paper, stating that they abound particularly at Barus and Khoonmoo, but are rarely in a very good state of preservation. Among them are several common and wide-spread European and American species, with a few that have not hitherto been noticed. They appear to be of Lower Carboniferous age.

In the introduction, Mr. Godwin-Austen gave a synopsis of the more remarkable facts brought forward in the paper, and in a *résumé* he gave lists of the fossils which had as yet been determined. These were forty-seven in number, forty-two of which had specific names, and twenty-two of which are well-known forms; eight are common to the Punjaub and Kashmere, seven of them being also European species. Of the Kashmere list, full half the species are found in British Carboniferous beds; and Mr. Godwin-Austen remarked on the support given to the notion of the approximate contemporaneity of distant formations containing the same fossils by the occurrence of these European Lower Carboniferous species near the base of the Carboniferous formation of Kashmere.

2. 'On the Mammalian Remains found by E. Wood, Esq.. near Richmond, Yorkshire.' By W. Boyd Dawkins, Esq., B.A, F.G.S. With an Introductory Note on the Deposit in which they were found, by E. Wood, Esq., F.G.S., and G. E Roberts, Esq., F.G.S.—These mammalian remains were discovered last autumn on a terrace of blue clay, mixed with limestone débris, about 130 feet above the north bank of the River Swale, during excavations for a new sewer. The deposit was stated by Mr. Dawkins to be a heap of kitchen refuse, and the great majority of the bones, except the solid and marrowless, are consequently broken, while not one of the numerous skulls is perfect. The collection contained bones of the following species:—*Ursus Arctos, Canis familiaris, Sus Scrofa, Equus, Cervus Elaphus, Cervus Dama, Bos longifrons, Bos brachyceros, Ovis Aries, Capra Ægagrus,* and the horn-cores of a third form of Goat, which appeared to be the *Ægoceras caucasica,* which had also been found by Mr. Dawkins and Mr. Sanford in a bone-cavern explored by them in 1863. In a note to Mr. Dawkins, M. Lartêt expressed his opinion that these horn-cores belonged to some of the diversified forms that are the result of hybridity, and stated that they resembled some found in a bone-cave in the Pyrenees, which appeared to belong to a hybrid between the Goat and the Bouquetin.

MANCHESTER GEOLOGICAL SOCIETY.—At a late Monthly Meeting, held in the Museum, Peter Street, Andrew Knowles, Esq., President, in the chair, Mr. SAINTER, of Macclesfield, read a paper upon the Macclesfield Drift-beds, and a description of a *Fulgurite* recently found in a sand-pit at Macclesfield.

For the last two years extensive operations have been carried on in the neighbourhood of Macclesfield, in the formation of a new Cemetery. It comprises about 25 acres, and consists chiefly of the Marine Drift-deposits. At its southern extremity there is a valley about 100 feet in depth, with a sloping ascent extending northwards to about 600 feet; and during the process of draining and levelling the ground, the nature and character of the strata, &c., were thoroughly exposed. Commencing from the brook upwards, we have first the Boulder-clay which forms its bed; it is a of a dull reddish-brown colour, very firm and tough, and is extensively used about Macclesfield, in the manufacture of tubing, bricks, &c. The valley-gravel overlies this clay; also soft loam and peat-bog, the latter being of variable thickness, from a few inches to 6 or 8 feet. Trunks of trees, chiefly fir, oak, birch, and hazel, were dug out of it; likewise some acorns and nuts. Connected with the brook, deep drains were cut diagonally at different levels on the hill-side to the height of 30 feet. These cuttings showed thick unstratified beds of wet and dry sands and gravels, with loam, of varied consistence and colour, the latter chiefly ochreous; likewise a few detached masses of Boulder-clay; and the whole series was pretty well packed with pebbles and boulders, and rough pieces of rock of all sizes and character. With the exception of those embedded in the Till or Boulder-clay, nearly all the rest have been derived from the higher levels, as the valley became gradually formed; and here some very large blocks of granite and porphyritic greenstones were dug out.

At the above height, tram-roads were laid one above the other, at intervals, across the acclivity, and the deposits were laid bare, and cut into in all directions. The exposed surface extended east and west to about 500 yards in breadth, and 60 feet in height, with a southern incline of about 500 feet. The surface-soil was about 18 inches thick, and below it, for 3 or 4 yards, was a deposit of soft ferruginous clay or marl, mixed with coarse sand or gravel; the whole crowded with water-worn pebbles and boulders, and irregular masses of rock, apparently of almost all ages, sorts, and sizes, and from all quarters of the compass. Below these accumulations stratified beds appear, consisting generally of both fine and coarse sand and gravel, with shingly pebbles, and some thin clayey beds, with a few thin layers of broken coal or shale; and, although for the most part the stratification is even and regular, yet in some places there exist oblique laminations with occasional curvings, and also intercalations of false- and current-beddings. There occurred likewise some remarkable vertical and diagonal interruptions, or intrusions, of very fine, clean, and bright running sand or gravel, of a light-brown colour.

Perhaps the most remarkable result attending those excavations has been the discovery of a large quantity of marine shells. In other parts of the country these have been frequently met with, but probably there are few places where they abound so much as in this vicinity. They are to be traced round the town and on the hills to an elevation of 1,200 feet. In the Cemetery-ground they make their first appearance about 10 or 12 feet below the surface, and for about 50 feet there is scarcely a bed of sand or gravel free from these exuviæ. Those that are found in clean sand or gravel are almost perfectly white, while others in clay partake of its colour. In the collection of shells brought here for your examination, about half the species were found in a fragmentary condition, and of these fragments some pounds were collected, but the great majority were too much defaced to be identified. *Turritella* and *Cardium* were the most plentiful; but very few indeed of these, in comparison with the number of their fragments, are perfect. The above, and *Patella*, *Purpura*, *Mangelia*, *Pecten*, *Fusus Bamfius*, *Ostræa*, and *Tellina*, were the first met with, at about 3 yards below the surface, embedded in fine stratified sand or gravel. At about 10 feet lower down, nearly thirty varieties were found in an almost perpendicular bed of fine and even running gravel. This bed proved to be 10 or 12 yards in depth, about 14 in breadth, and 4 or 5 in thickness. More perfect specimens were taken out here than at any other part of the ground; especially *Murex*, *Nassa*, *Purpura*, *Litorina*, *Dentalium*, *Venus*, *Mactra*, *Natica*, *Trochus*, *Turritella*, *Aporrhais*, and *Cardium*. The floor of this bed was a thick stratum of rather wet sand. At this point the shell-deposit appeared to terminate; and it was the lowest level reached by the labourers above the drainage-operations before mentioned. On the same horizon as above, at a short distance eastward, in a small bed of fine-running gravel, four or five *Cypræa europæa* were found in a perfect condition; likewise *Cytheræa Chione* and *Cyprina islandica*, both fragmentary, and a large *Buccinum undatum* in very good condition. But some of the larger shells are indebted for their preservation to their being embedded in a more clayey medium. Each separate cutting presented more or less a change in sorts; but the most fragmentary and universally distributed proved to be *Turritella*, *Cardium*, *Tellina*, *Mactra*, *Buccinum*, *Mya*, and *Cyprina*. In a thin bed of fine sand, upon an upper level, there were found some very minute shells in a wonderful state of preservation, viz., young of *Turritella*, *Nassa*, *Mangelia*, &c. These beds of fine sand and gravel were the most prolific.

Not much less striking than the discovery of those shells is the circumstance of the extraordinary quantity and variety of rock-specimens, &c., which have been associated with them. The Boulder-clay of this neighbourhood contains, I believe, upon the whole, about the usual number of igneous rocks which are found in it elsewhere; although at the southern extremity of this town, there are some very fine beds of it entirely free from pebbles and everything else, except pieces of drift-wood and fragments of coal. In the Cemetery-ground, the greenstones predominate in the Boulder-clay; next come the granites, felstones, porphyries, &c., the whole more or less polished, scratched, or grooved. Blocks of quartz-rocks are sparingly seen; but pebbles of it abound everywhere, and of endless design and colour. But it is the bed about 2 or 3 yards in thickness, immediately below the surface-soil, that contains the greatest variety of rock-specimens, foreign, native, and local; and although it contains igneous rocks similar to those in the Till, with others of like nature, still the Carboniferous and Silurian grits and sandstones exceed in abundance all the rest.

I will now refer to some of those specimens lying before you of the Local Drift, which extends for a few miles about Macclesfield, since they are very conspicuously represented in the above bed, viz. :—rough pieces of Millstone-grit (chiefly specimens of the first, third, fourth, and fifth beds) ; and also those of the Yoredale rocks, all from the adjacent hills lying eastward. Likewise, from the same district, specimens of the Lower Coal-measure Sandstones, containing *Sigillaria*, *Stigmaria*, *Calamites*, *Coniferæ*, &c.; also detached pieces of Coal, and blocks of Gannister-sandstone, with impressions of *Stigmaria* and reed-like plants; and lumps of Fire-clay studded with fossils.

From the neighbourhood of Buxton, twelve miles off, come fragments of Carboniferous Limestone, generally in a nodular form, of all sizes, well water-worn, and very plentiful, containing fossil shells : likewise rough pieces of the same, composed entirely of Encrinital stems ; also lumps of and single Corals.

Specimens of the Second Bunter and Permian sandstones. The nearest point to Macclesfield, where the former crops out, is at Bollington, four miles north-east ; and both appear at Rushton, seven miles south. The Second Bunter passes under the town, with a north-westerly dip, at about 25 yards in depth, overlain by the Drift and débris from the adjoining hills.

From Alderley Edge, five miles north-west, specimens of the Lower Keuper conglomerate-sandstone, and the green and blue carbonates of copper-ore : very large masses of the latter were found just below the alluvium. From the same hill likewise, the brown and yellow sandstone, or building-stone, some of this being well rolled and waterworn; likewise gypsum, barytes, iron-ore, and pyrites. Scattered about with the above, either in clayey beds, or rough sand or gravel, there were some rounded and elliptically rolled lumps of indurated clayey conglomerate, containing small pebbles and shells, the latter chiefly in fragments.

From Newbold Astbury, near Mow Cop, ten miles south-west, Carboniferous Limestone, with some of its peculiar local fossils, besides Limestone-shale. From Congleton Edge, nine miles south, specimens of the First and Third Grits, which are iron-stained in a particular manner not noticeable elsewhere. Coming from a greater distance, probably from the Welsh Borders or Cumberland, specimens of the Silurian grits and sandstones, a few of them bearing fossil shells; and, with these, I include two or three rounded lumps of what appears to be an impure graphite.

There is no Upper Boulder-clay in the Cemetery-ground; but small and shallow breadths of it appear at intervals along a course of two or three miles to the west; and, at this point, the Drift-deposits reach their maximum thickness, about 300 feet; and this is at an elevation of about 600 feet above the level of the sea.

I also exhibit a cast of a Net-sinker. The original, which I have presented to the British Museum, is made of burnt clay, and is probably of very early English date. It was discovered a few feet below the surface, in the lower part of the valley.

The Fulgurite which I have brought for your inspection was got out of a bed of fine dry sand on the south side of Macclesfield, about three years ago; it was traced in a straight direction to a depth of 22 feet. This was a work of some difficulty, owing to its brittleness, and only short lengths of it were at intervals secured. Towards the surface its diameter had been about three-quarters of an inch, and it tapered gradually throughout its course to about 3 or 4 feet from its termination, when it took a slanting direction, and then assumed the form of several filaments, which eventually became dispersed and obliterated in a soft spongy clay.—*Macclesfield Courier and Herald.*

GEOLOGICAL SOCIETY OF GLASGOW.—On Saturday, May 13th, the Society had their first Excursion of the summer session to the Rye Water and surrounding district, under the guidance of Mr. James Thomson.

The Rye Water, to which Mr. Thomson first led the party, is a small stream—a short distance from the town of Dalry—which receives the drainage of the range of hills forming the northern boundary of the Ayrshire Coal-field. Its banks exhibit many interesting and instructive sections of Carboniferous strata; in some parts they have been cut to a considerable depth by the stream, exposing the strata from the lower nodular Ironstone of the Ayrshire basin, down to the base of the Mountain-limestone,—all of which beds have been much disrupted by numerous dykes of greenstone and coarse gritty tufa.

On the way, a visit was made to some ironstone pits, where the lowest black-band is found, 2 feet in thickness; and after a walk of a mile over gently rising ground, the party struck the Rye Water at a section where the lower nodular ironstone is exposed, and a bold escarpment of rocks is seen, tilted up by a trap-dyke, which dips to the south with a strike E. to W. After an examination of this section, the stream was ascended for a short distance to a section on the east bank, where the lowest black-band ironstone is exposed, and had led to the search for an extensive working of this seam in the surrounding district.

A little farther up the stream, the party reached the high cliff at Cuningham Badlane, on the west bank, exhibiting one of the finest sections in the West of Scotland. This section is composed of Carboniferous limestones and sandstones, with interlaminary shales, underlain by tufa containing angular fragments of sandstone. At the foot of the cliff numerous blocks of the limestone strew the bed and banks of the stream. The Members spent some time here, and found numerous fossils in these and in the thin bands of limestone from the base of the Coal-measures on the opposite bank. The fossils found here comprise Corals, Polypes, Brachiopods, Lamellibranchiates, Gasteropods, Fish, &c., many of which are rare. Mr. Thomson next led the party to the dyke formerly referred to, and which crosses the Rye Water diagonally: it is a compact greenstone, and he drew attention to its effect upon the limestone on its western side, which it had altered from a dark greyish blue into a dull light-brown. This, where exposed, has yielded to atmospheric influences, leaving in many parts the fossils, consisting of several species of Corals, and even the slender form of *Lithostrontium junceum*, Milne-Edwards, projecting an inch above the surface of the weathered rock. On the east side of the dyke—here 40 feet broad—the section in the bed of the stream shows tufa, overlain by shale, in the upper portion of which was found *Orthis Michelini* in great abundance: overlying the shale there is a thick band of limestone, above which occur the thin layers of limestone already mentioned, interlaminated with calcareous shales, in which numerous fine fossils were found. These shales again are overlain by thick beds of bituminous shales and impure coal, and the whole are capped by a thin bed of sandstone, the section altogether showing here somewhere about 150 feet in thickness. Mr. Thomson mentioned that he had seen sections of the same strata in Arran, Ayrshire, Lanarkshire, Linlithgowshire, and along the coast of Northumberland; and that similar thin beds of limestone and shale were common to them all, and their characteristic fauna are the same.

The Members next visited a limestone-quarry on the farm of Bedlay, where some good fossils were got, and where an hour or two could have been well spent, had time permitted. From this Mr. Thomson led them southwards across the district, pointing out by the way the effect of the numerous dykes upon its physical features, the undulating aspect of which is characteristic of the Ayrshire Coal-field, from its north-western extremity to Muirkirk on its south-eastern boundary. Following the course of the trap-dyke above described to a beautiful amphitheatre on the Calf Water, it was again seen there ejected through the shales and upper limestone of the district. From this point the stream was followed down to the Lixu-spout, where it has cut its way through the lime and sandstones to a depth of not less than 150 feet; below the waterfall there has been a downthrow of the strata, leaving a vertical wall of bare lime and sandstone-rocks, over which the water falls. The stream has here also scooped out another amphitheatre, in the shady depths of which the party rested.

NORWICH GEOLOGICAL SOCIETY.—At the last Monthly Meeting of this Society, the first paper read was *On a Section in the Drifts at*

Whitlingham, by the Secretary, Mr. TAYLOR. The Lower Drift, in the neighbourhood of Norwich, is often accompanied by a stratum of pebbles cemented together by oxide of iron and manganese, and known by the local name of 'Iron Pan.' It is to be seen in several places near Thorpe, at Trowse, and at Whitlingham. Its presence on the higher grounds on each side of the river shows that it once covered the area of the valley, prior to the scooping out of the latter. The bed of shells at Whitlingham rests *immediately* beneath this 'Iron Pan' stratum, and is about 4 feet in thickness. The position of the Whitlingham shell-bed is about in the middle of the Lower Drift. The shells are in every degree of individual age, proving that they lived, bred, and died on the spot; many of them are very fragile, and could not have stood the rough usage of re-deposition. The most plentiful shell is the common Cockle (*Cardium edule*), the next the common *Tellina*, also in various stages of growth. The common Mussel (*Mytilus edulis*) also occurs in great quantities. Among the rest were the following:—*Turritella communis*, fragments of *Cyprina Islandica*, *Mya*, *Mactra*, *Littorina*, *Venus*, and *Astarte*.

Singularly enough, these shells betoken a cold climate; but the abundance of individuals of species now living in British seas would argue for the Celtic character of the mollusca, were there no other facts. The author also obtained two specimens of *Cardium Grœnlandium*—a decidedly *Arctic* type. *Astarte borealis*, another northern shell, is also common. In addition to these may be mentioned a species of *Venus*, *Cyprina Islandica*, and *Mya arenaria*, all of them more or less of an Arctic type, and now living in the cold seas of the far north.

The Rev. JOHN GUNN, F.G.S., then read a paper *On the Dip of the Chalk in Norfolk*. Mr. Rose has estimated the dip of the chalk in this county at about 5 yards per mile; but in this paper the author cited a number of facts in support of his conclusion that the average dip is, from Norwich to Yarmouth, nearly 30 feet per mile. Mr. Rose had remarked to the author that the apparent amount of dip was due to the crossing of the valley and estuary at Yarmouth. This opens a most important and highly interesting subject for consideration and discussion, and called the author's attention to Mr. Prestwich's paper on the well-boring at Yarmouth. On looking over the specimens of the boring, which are carefully preserved at the brewery, Mr. Prestwich noticed that there were 50 feet of blown sand and 150 feet of recent estuarine deposit, when the London clay at once commenced, and reached 310 feet; then followed 46 feet of the Woolwich and Reading series, and the chalk with flints was gained. Now, it is evident that, as the chalk was covered by these early Eocene deposits, it could not have been denuded by any river-action connected with the present estuary or valley. Mr. Prestwich shows that the London clay occupied here a part of the basin of the chalk, 'and that probably a bed of variable thickness of it may extend beneath the Crag between Orford and Yarmouth, and may possibly range as far north as Mundesley and Bacton.'

'This mass,' he observes, 'cannot extend far inland, as the chalk comes, at places, to or near the surface, along a line about ten to fifteen miles distant from the coast. From this line, as the chalk dips eastward, the Eocene strata may probably set in, and, dipping also eastward, pass out under the bed of the adjacent German Ocean.' From this it is evident that the dip of the chalk at Yarmouth is unconnected with the formation of the present estuary or valley. The recent estuarine deposit, however, does belong to it, as appears from the escarpments of the Crag and glacial Drift on either side at a higher level. These, it seems most probable, extended over from side to side; and the post-glacial valley-formations have cut through them and scooped out the bed of the river and the estuary at a comparatively recent geological period. It appears that the formation of the present valley and estuary did not commence until after the partial emergence of the land from a glacial sea, and has no relation at all to the dip of the chalk. Many places may be pointed out where the dip of the chalk does not exceed five yards per mile—as, for instance, at Weybourne and Runton—and the observation of these may have led to the conclusion that such is its average dip in this county; but it must be estimated by the general result on an extended scale, and without reference to partial variations arising from the causes which have operated locally. The very interesting contortions in the chalk, pointed out by Mr. Taylor, at Whitlingham, prove that the dip may be varied in a very limited area by subterranean forces; but the line of the chalk from the extremities of the county, Hunstanton and Yarmouth, maintains a uniform dip notwithstanding. It has always been a difficult problem to solve as to the period when the chalk assumed its present inclination from the west eastward. This discovery of Mr. Taylor bears importantly upon it, because the chalk must have been in a very soft and plastic condition when these contortions were thus caused, and therefore they, probably, took place soon after the deposition of the chalk; and it seems that the basin in which the London Clay and Lower Tertiaries were deposited, was formed by the upheaval of the chalk to the west. These Eocene deposits followed so closely upon the Upper Cretaceous beds as not to allow a very long geological period to intervene between their deposition and that of the chalk.—*Norwich Mercury.*

COTTESWOLD NATURALISTS' FIELD-CLUB.—The First Field-meeting of the Club for the present season was held at Stroud, on 24th May. The Members assembled at the Midland Railway Station, at Stonehouse, shortly before 11 A.M., and first proceeded to inspect some objects of interest at Stonehouse Court, where Mr. Henry Marling met them, and afforded every information. The party then separated, some of the geologists, headed by Mr. Witchell, taking their course to the quarries on Doverow Hill, where the sections disclose the *Cynocephala* stage of Dr. Lycett.

The other detachment made their way across the fields to Stanley St. Leonards, and spent two hours very pleasantly in inspecting the ancient and interesting church in that village, with the remains of the old priory in the manor house adjoining.

The Members of the Club, who had been joined by the Geological Section from Dovcrow Hill, now proceeded to Stanley House, where they were most handsomely entertained at lunch by Mr. and Mrs. W. H. Marling.

From Stanley House the Members followed the course of the Stonehouse and Nailsworth Railway to the Lightpill cutting; and then leaving the line, made their way to the gasworks, to examine a fine section in the upper beds of the Lower Lias, now exposed to a depth of 20 feet in the excavation for the new gasometer.

The Club assembled for dinner at the George Hotel, Stroud, about 5 P.M. After dinner, Mr. Lucy (who occupied the chair) read a communication from Mr. John Jones in reference to the occurrence of *Helix lamellata* in a sub-fossil state in a deposit at Stroud, and enclosing a note from Mr. Gwyn Jeffreys, in which its occurrence at Coptford in Essex, in a Post-Pliocene deposit, and in a living state at Anglesey and in nearly every part of Ireland, was noticed.

The Rev. F. Smithe, at the request of the Chairman, gave a short account of the proceedings of the Geological Section during the day. He said that the cutting on the Stonehouse and Nailsworth Railway had proved to be interesting, not only on account of its fossil contents, but also from the fact that the excavation affords an opportunity of examining a zone of the Middle Lias, or a series of beds, that are never worked for their intrinsic value—for the workings into the Marlstone for the sake of 'road-metal' always stop short of the peculiar underlying beds that had been visited to-day. Wallets might here soon be filled with the characteristic fossils of the section. The zones included extend from the *Ammonites spinosus* to the *A. Jamesoni*, and well deserve close working; they constitute the 'Micaceous Sandstone' of Murchison. A few of the leading shells met with were as follows:—*Ammonites maculatus*, common; *Belemnites brevis*; *Myacites, sp.*, abundant; a large *Pinna*, not unfrequent; *Monotis inæquivalvis*; *Arca*, not unlike *A. Buckmani*; *Rhynchonella concinna*; large *Pecten*; *Modiola scalprum*; *Pholadomya ambigua*; and remains of Crinoidea. He thought it would be very desirable to search for the Leptæna-bed, which he had found on Chosen Hill in a similar geological position.

Mr. Witchell stated that he had found the Leptæna-bed in some cellar-excavations near the Railway Station at Stroud, where it was about the same thickness as on Chosen Hill—from one to two inches; and he had no doubt it would be found in the Lightpill cutting. He then called attention to the gravel-beds at Stonehouse, and at the Gasworks section, and inferred from their condition that considerable changes occurred during the period in which the bottoms of the Stroud valleys had been excavated, and the deposition of the gravel, and afterwards of the peat, had taken place. All these gravels rest upon excavated hollows in the Middle and Lower Lias.

This subject will be further investigated by the Club at a future date.

THE OSWESTRY AND WELSHPOOL NATURALISTS' FIELD-CLUB held their first Excursion for the season on June 1st. The Members assembled at Shrewsbury at 10 A.M., and proceeded first to inspect the Museum of that town. Besides a nice series of fossils from the Upper Secondary strata, the Members were interested in some specimens of flint implements and weapons, and also some beautiful examples of bronze weapons, found near Guilsfield, Montgomeryshire. They then walked along the banks of the Severn, and afterwards by the side of the canal to Pimley, and thence to the fine old ruins of Haughmond Abbey. The canal was being cleared from that pest to navigation, the American weed (*Anacharis alsinastrum*); and from among the heaps raked out upon the towing-path, some rather rare freshwater Shells were obtained. The Botanists were gratified by finding some rare plants, which grow among the ruins of the Abbey. There is but little to record geologically. The walk lay for the most part over the Permian Rocks, which here are covered by a thick deposit of reddish ferruginous Clay, interspersed with boulders, but no rock-sections are exposed. Haughmond Hill, on which the Abbey stands, consists in its central portion of a mass of hard, very compact, and fine-grained unstratified Greenstone, which is well exposed in a quarry where the road from Shrewsbury to Newport gains the crest of the hill, for 'road-metal,' for which it is well adapted. The Greenstone may be traced along the summit of the hill to the abrupt termination of the latter, on which the 'Sham Castle' stands, while on either side of it may be seen the dark purple Cambrian Grit and Conglomerate, through which it has protruded along the whole length of the hill. These Cambrian Rocks are well seen near the Abbey, and consist of coarse-grained, rather crystalline Sandstone, a material not the most favourable for the preservation of organic remains in formations where these were plentiful. Hence the search for some of the few forms of the lower orders of life which are so rarely found in these old rocks was unsuccessful, for, save some doubtful traces of Annelides, no fossils were found.

The party then returned to Shrewsbury by way of the pretty village of Uffington, and sat down to an excellent dinner at the Crown Hotel, the President R. G. Jebb, Esq., of the Lyth, near Ellesmere, being in the chair. After dinner, the Rev. T. E. Jones, of Selattyn, was elected a Member, and six gentlemen were proposed as candidates for admission at the next meeting. The next meeting was fixed to be held at Llyncliss and Sweeney on the 13th of July. On the proposition of Mr. D. C. Davies, it was resolved to subscribe two guineas annually to the Palæontographical Society. The President then gave an interesting account of the discovery of a very ancient shield on Bagley Moor; and Mr. T. Parrot exhibited some fine specimens of *Calymene* from the Bala Schists of Cyrn-y-brain, near Llangollen; and a *Pecten* from Monte Mario, near Rome, was shown by the Secretary, Mr. H. M. Gwyther.—D. C. D.

DUMFRIES AND GALLOWAY NATURAL HISTORY AND ANTIQUARIAN SOCIETY.—The last In-door Meeting of this Society was held in the

Assembly-street Club Rooms,—Dr. Gilchrist, Vice-President, in the chair. There was a very numerous attendance of Members. Several new Members having been admitted, and other preliminary business transacted, Mr. W. M'Diarmid read an account of the Lady Devorgilla, the mother of John Balliol, King of Scotland, founder of Sweetheart Abbey, and builder of the Old Bridge over the Nith at Dumfries.

The Secretary then read a paper, contributed by Dr. Crisp, 'On the Anatomy and Habits of the Spoonbill (*Platalea Leucorodia.*)'

Dr. Gilchrist then read a short paper in continuation of his researches on the ancient sea-beaches of the Nith valley. His attention had been confined to the terrace which was seen commencing on the left bank of the Nith, immediately below the caul at Dumfries. The corresponding terrace on the other side was that which formed St. Michael's Street. He was of opinion that these terraces were of marine origin, as he had certain information that marine shells had been discovered in the soil near the brickworks at the shooting range. He was still in the midst of his researches, and would communicate the results from time to time to the Society. Dr. Grierson also exhibited some interesting fossils from the Silurian rocks at Dunscore. In one there was a circular marking that reminded him of the markings noticed in a paper which had recently been sent them from the Isle of Man. He had also been supplied by Mr. Corner, of Fraserford, with a specimen of Graptolite from the Silurian strata near Dunscore, which was the first time, he believed, that they had been found there, although they abounded in the valley of Moffat Water.

A lengthened paper on the Fire-clay of Edinburgh, contributed by Mr. Marshall, was presented, but was only partially read, owing to the lateness of the hour.

Dr. Grierson, Thornhill, exhibited a number of skeletons, &c.—also two specimens of muslin of very fine texture, made from the leaves of the Pine-apple, from the Island of Penang.

The first Field-meeting was fixed for the 1st of June, when the Society is to visit the ancient camp at Burnswark in Annandale.—*Dumfries Herald.*

North Staffordshire Field Naturalists' Society.—On Saturday, the 13th of May, the North Staffordshire Field Naturalists' Society commenced their summer rambles by an excursion to Biddulph and its vicinity. The Society has been recently established, and this was its first field-day. There was a muster of about forty Members from Stoke, by train to Gillow Heath, where it arrived about 1.30 p.m. A walk to the top of Cloud, a distance of about three miles, in order to examine its botany and geology, was a part of the day's programme; but this project was abandoned in consequence of the lateness of the hour of arrival, and the company confined themselves to viewing the gardens at Biddulph Grange, which are of world-wide reputation, and likewise of examining the fine collection of fossils in the geological gallery. They afterwards proceeded to inspect the picturesque ruins of the castle, which is renowned for its siege during the Civil War. Mr. C. Brocklehurst and Mr. Sainter, from Macclesfield, joined the excursionists by invitation; and at the close of the very agreeable day's proceedings, the latter gentleman read the following interesting paper *On the Geology of Cloud Hill* and the adjacent country:—'Cloud Hill is about 1,200 feet above the level of the sea; it is capped by the Millstone-grit, and is composed of three beds, namely, first, third, and fourth grits, with shales between each, and the thickness amounts to about 500 feet. The second bed is not represented. The first, or uppermost bed, technically called "Rough Rock," is a coarse massive sandstone or grit, and it forms almost invariably the floor of the Coal-measures. It averages in a remarkable manner throughout its whole course about 100 feet in thickness. On the borders of Lancashire and Yorkshire, near Mottram, the Millstone-grit series consists of five beds, which exhibit a total thickness, with their shales, of about 3,000 feet. On tracing these grits southwards, the beds become gradually thinner; and at about ten miles south-west of this locality, three of the beds have died out; leaving the first and third, with their shales, at a thickness only of about 300 feet; as may be observed on the margins of the Wetley and Cheadle Coal-fields. The second bed of grit, which consists mostly of a brown, flaggy, fine-grained sandstone, can be traced no farther than a little to the south of Shutlingslow. This hill (Cloud) forms a very striking feature in the surrounding landscape, and presents a development of the first and third grits, particularly the latter, which is generally celebrated for its massiveness of structure and its long lines of steeply scarped hills, that contrast so strongly with the undulating plains of Cheshire. But while I am dwelling upon the physical features of this part of the country in relation to scenic effect, I must say a few words of a more useful and practical character; and that refers to the position of this hill with reference to the Coal-measures below it on its western aspect, as these form the most northerly point of the North Staffordshire Coal-fields. The whole of these beds of coal, with their sandstones and shales, are contained in a basin or trough, called the Biddulph Trough; and this hollow is formed by the two beds of grit before named, which pass under these Coal-measures, and crop out again on the opposite side of the valley, forming the bold ridge of Congleton Edge, and the fantastic denudations of Mow Cop. The fourth bed of grit is quarried below the eastern side of Cloud Hill, but it extends not much farther westward, since it does not make its appearance on its proper horizon at Mow Cop or Congleton Edge. Eastward, this bed (the fourth) forms the romantic scenery around the banks of Rudyard Lake, and it gradually dies out near Cheddleton, after having exhibited on the confines of Lancashire, Yorkshire, and Derbyshire, an enormous mass of gritstone and conglomerate, about 1,000 feet in thickness. The fifth bed terminates in the Rudyard Basin near the Wetley Coal-field; and although it has been as regular and persistent in its course as the fourth bed, still it has held in general a subordinate relation to it with respect to industrial purposes; since the fourth bed is more easily attainable, and is superior in quality as a building stone. Stretching northward from the extreme point of Cloud, at a much lower level, we have the Yoredale series of rocks, so named from a locality in Yorkshire. This section of the Carboniferous system lies immediately below the grits, and it exhibits in this neighbourhood thin-bedded and coarse-grained sandstones, with dark shales, and occasionally thin earthy limestones. This series enters into the composition and structure of the long ranges of Bosley Minn and the Gun; also the sharp anticlinals of Biddulph Moor, besides, according to Messrs. Hull and Green, embracing at intervals, when not overlain by the Millstone-grit and Coal-measures, an extent of country from Cloud to Cheadle, near Alton, to Hartington in Derbyshire, and to Hayfield in the same county, and also to Marple, near Stockport. These rocks reappear near Stalybridge; and northward, in the Saddleworth valley, their thickness is not less than 2,000 feet. In the neighbourhood of Macclesfield, where I am pretty well acquainted with the deposits, the Yoredale series have thinned down about 800 feet. There also the first bed of grit is about 100 feet in thickness; the second bed, 150; third, 200; fourth, 100; fifth, 60: and add to these 400 feet for their intervening shales, we have a total thickness of 1,000 feet. I have now given you a short abstract of the different beds of grit, &c. as they relate more especially to the locality we have visited to-day. If we had been favoured with more time, and had extended our ramble to Rushton, there is a much wider field of interest and exploration at that place. For along with those beds of grit (excepting the first and third) and the Yoredale rocks, there are to be seen and studied some outliers of the Permian marls and sandstones, and the pebble-beds of the Bunter series.'—J. D. S.

THE WARRINGTON FIELD NATURALISTS' SOCIETY held their Third Annual Meeting at the Mechanics Institution, on the evening of May 10th, under the presidency of T. G. Rylands, Esq., F.L.S., &c. Mr. Greening, Mr. Milner, Mr. Green, and many other gentlemen, exhibited microscopes and objects of Natural History; and papers were read by Mr. Peers, the Honorary Secretary, and by Mr. Green.

Mr. PATERSON read an exceedingly interesting paper on the Geology of the District. After describing the position of the New Red Sandstone formation (to which the rocks immediately surrounding us belong), he stated that the Permian may be seen in a cutting on the Manchester and Liverpool Railway, where it is crossed by the St. Helen's and Runcorn Gap line. It appears to form a belt, about half a mile in width, from the Grange, north of St. Helen's station, in the direction of Parr and Sutton Mill, and on to Rainhill, where it is thrown out by a fault. Pebble-beds occur in the same neighbourhood: a deposit may be seen in an old quarry by the roadside at Winwick, in a dell between Newton Heath and Earlestown village; also at Newton and the railway cuttings to the east. In an industrial point of view, these beds may be regarded as the most valuable in the Triassic series, the stone being comparatively hard, and less liable to disintegration from atmospheric influences. It appears highly probable, from the aspect presented in our immediate neighbourhood, and eastward, that the Bunter formation had been considerably upheaved and subjected to great denudation previous to the deposition of the Keuper; for it did not appear that the Bunter—which was 650 feet thick—was found on any of the promontories north of the Mersey; it was seen only on the low-lying plains from Widnes to Warrington, and along the river-valley eastward; and at Hill Cliff, where the lower beds of the Keuper are quarried for building purposes, they appear to lie unconformably upon the pebble-beds of the Bunter series. After making some remarks on the Lower Keuper, he concluded by referring to the forms of life which presented themselves during the New Red Sandstone epoch.

Mr. Paterson exhibited a geological section of the country from Weston Point to Halton.

The President expressed, on behalf of the Society, his warmest thanks to Mr. Paterson for the paper he had read.

The Revs. W. Hamilton, J. D. Massingham, and R. R. Moore addressed the meeting; and after a vote of thanks to the Chairman, the Members separated.—*Warrington Guardian*, May 13.

CORRESPONDENCE.

ORIGIN OF ROCK-BASINS IN NEW ZEALAND.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—As I had erroneously been led to believe that my eminent friend Dr. Hector, who conducts the Geological Survey in the southern portion of New Zealand, had adopted the same view as Dr. Haast respecting the power of Glaciers to excavate basins in hard rocks, I now transmit a letter I have recently received from him, which shows that his opinion is very different indeed to that which has been attributed to him. In fact, the views of Dr. Hector seem to coincide with those of the geologists who, like myself, refer in great measure the formation of valleys and lake-cavities to ancient plications and ruptures of the strata—doubtless deepened in mountainous countries, whether by ice or water.—Your obedient servant,

July 14, 1865. RODERICK I. MURCHISON.

DEAR SIR RODERICK,—I feel greatly obliged to you for the trouble you took in laying the notes on our Geology before the Society, and for your kind expressions respecting my labours. It is only lately that I have been able to settle down to work up the materials I have amassed, so that there are many points only now becoming clear to my mind.

I am afraid that, with respect to the Glacier-erosion of valleys, you are confusing my views with those of Haast. I cannot at all agree with him, as to the power he attributes to Glaciers, of excavating the floors of their valleys, so as to form rock-basins, unless it can be shown that they are advancing with the dip of soft-bedded strata which flank the harder rocks that form the mountains.

I believe that instances of this kind have occurred in New Zealand, especially on the west side of the mountains.

The great valleys, however, which exist in the Crystalline rocks, and which are 'rock-basins,' *have become so by unequal axial motion*, which, in the case of Otago, has generally been a subsidence of the mountain-centres, more rapid on the west than the east, and accompanied by a rise of the flanking formation. However, I can have no doubt that in the schistose formations, and other stratified rocks having alternations of hard and soft beds, the valleys have been excavated in the strike of the soft strata by simple erosion.

In the case of the massive Crystalline rocks, I have reason to suppose that the valleys, such as are occupied by the true coast-sounds, have originally followed lines of injected basic rocks, that invaded the crystalline mass subsequent to its original metamorphism, and which basic rocks, decomposing more freely than the gneissic group on the subsequent elevation of the land, gave way before the descending ice. It seems to me that the essential condition to the existence of glaciers is a lofty plateau, or slightly inclined mountain-top, on which the snow rests in sufficient quantity to descend into the lower levels as its only means of escape. The greatest erosion takes place where it descends over the edge of this plateau, or '*breeding-ground*;' and if there is a soft 'run' in the rocks, it must cut a notch there which will extend into the higher country as a deep valley. I believe I can prove that it has been thus that all our principal valleys have been formed. Ice is only, after all, one of the ordinary destructive forces, the effect of which has, perhaps, been rather underrated; but there has been no *new* erosive agency added to that formerly known to geologists. The ice-fall acts just like a great cascade in a river, at which point the greatest erosion goes on—that which is effected by the gently running part of the stream being small. The only supposed new point in these discoveries is the excavation, or ploughing action, by the ice of the glacier after it has descended to the valley-level, and with that I certainly do not agree.

Trusting that I can shortly support my views with full details, I remain, my dear Sir Roderick, yours sincerely,

JAMES HECTOR.

DUNEDIN: *April* 18, 1865.

GEOLOGY OF MATLOCK AND THE NEIGHBOURHOOD.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—Allow me, through the medium of your Magazine, to direct the attention of Geological tourists during the ensuing autumn to some interesting spots in a part of Derbyshire not yet sufficiently known. The Mountain-limestone around Matlock presents very instructive sections, which have lately been extended by quarrying.

A Geologist may now be able to ascertain whether there is a real fault between the High Tor and Masson Hill, or whether the fault be only apparent through the falling down of the strata on the western side of the great rent to which the Tor originally owed its existence. A part of the *second* or under bed of *toadstone* may now be seen near Mr. Stevenson's Paint-works, under the High Tor. Shreds or fragments of raised beaches may be recognized behind Matlock Bath and other parts of the valley; but the finest specimens of raised beaches, of dimensions admitting of being explained by ordinary earthquakes, may be traced to the south of Cromford, on the right hand of the Cromford and Wirksworth Road. The Black Rocks to the left of the road, at a much greater elevation, reveal in a very impressive manner the action of oceanic waves, tides, and currents. The angles of the jointed blocks of hard Millstone-grit, and in many instances the fractured surfaces, appear as if they had resisted atmospheric action or *weathering* for thousands of years. Furrows, a few inches in depth, have in some places evidently been worn away by rain; but very few signs of the effects (in the shape of powdered grit) of pluvial disintegration can be discovered, while several of the crevices are partly filled, not by decayed grit, but by a sandy calcareous clay of the same nature as that which may be seen covering considerable areas in Matlock Valley. This clay contains fragments more or less rounded, and was probably deposited by the sea during the last submergence of the land. The Black Rocks have acquired their present shape, not by disintegration, but by the displacement of blocks, leaving walls and pillars, with intervening passages, the sides of which are nearly as fresh-looking as when the rocks were jointed. Here the Geologist can likewise see rock-basins on the sides of the cliffs, and in positions to which an undermining agency only could have had access. But such hollows on the sides of rocks are more common on Stanton Moor, a few miles to the north-west of Matlock. There also may be seen pillars of rocks like chimneys, consisting of square blocks, apparently piled up, but really the remaining fragments of jointed strata. Farther north, on the other side of the Derwent, the Millstone-grit rises in pillars, like the Cheese-wring of Cornwall. Here they are called 'Batches of Old Cakes.' That they are very old is evident, for their shape cannot be explained by any weathering process now operating on the spot, but would seem to point to the lateral action of the sea. Some kinds of Millstone-grit are peculiarly adapted to resist weathering. The longer they are exposed to the atmosphere, the harder their surfaces become; and, with their usual mossy covering, I am convinced they may retain certain shapes for a very long period. The Post-office and other houses in Cromford were built seventy years ago, and the marks of mason's tools are now as perfect and fresh-looking as when the stones were hewn.

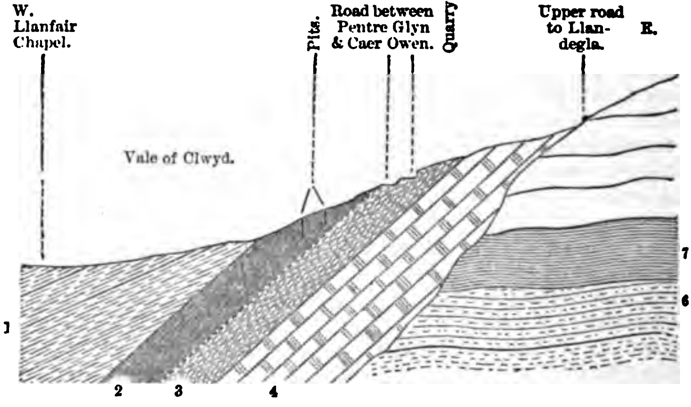
Behind Matlock High Tor there is a deep rent, the bottom and ramifications of which have been partly filled with a kind of sand, quantities of which have been brought to the surface during lead-mining operations. An examination of the sediment in this rent, or roofless cave (excepting where it is covered by a sea-worn arch), might lead to a better understanding of the origin of deposits in caves. Here no fresh water could ever have percolated to any extent, as the High Tor is surrounded by low ground.

On the footpath between Cromford and Bonsall, I have seen smoothed surfaces and markings on the limestone rock, which, if they are not glacial, are probably as much so as many phenomena which are attributed to icebergs, if not to sub-aërial glaciers. I believe the rock is called the *Bloody Stone*. D. MACKINTOSH.

PERMIAN STRATA IN THE VALE OF CLWYD.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—I have recently observed on the eastern side of the head of the Vale of Clwyd, a small exposure of Permian strata, intervening between the Bunter Sandstone and the Mountain-limestone. The Permian is not marked on the map of the Geological Survey as existing anywhere in the Vale of Clwyd; and as its occurrence gives evidence of even still greater antiquity to an important erosion of the Mountain-limestone of North Wales than that mentioned by Professor Jukes in your last number, I send the accompanying sketch-section for publication in the Magazine.


W.
Llanfair Chapel.
Pits.
Road between Pentre Glyn & Caer Owen.
Quarry.
Upper road to Llan-degla.
E.
Vale of Clwyd.
7
6
1
2
3
4

1. Bunter Sandstone, dip 20° to 30° N.W.
2. Permian Marls.
3. Purple Shales, Sandstones, &c. Dip. 42° S.W.
4. Carboniferous Limestone. Dip about 40° S.W.
5. Slates and Grits.
6. Denbighshire Flags.
7. Upper Silurian.

SKETCH-SECTIONS NOT DRAWN TO SCALE.

On the Geological Survey Map, sheet 74, the Mountain-limestone near Llanfair Chapel, forming the eastern boundary of the vale, is represented about a third of a mile in width. It is, however, between Pentre Celyn and Caer Owen, much narrower; the whole of the space to the west of the road, and part of that to the east, consisting of an alternation of red marls, variegated shaly beds and purplish sandstones, and pebble beds, with some impure concretionary limestone, dipping about 42° to the S.W., and resting with an apparent conformity on the denuded surface of the Mountain-limestone, which in this part of the vale has a similar dip. These beds were probably not visible at the time of the Survey, but are now exposed in quarries to the east and west of the road, and have recently been pierced by some pits sunk in search of hæmatite on its western or lower side. They are very distinct in mineral character from both the neighbouring Millstone-grit and the Bunter Sandstone of the vale, and are an exact counterpart of the Permian series of Shropshire.

The Bunter Sandstone is well exposed a mile to the north-west at Garth Gynan, where it dips north-west about 25°, and would appear to be unconformable to the beds at Pentre Celyn, but the junction is not visible.

Although the supposed Permian strata appear to rest conformably to the Mountain-limestone, the extreme thinness of the Limestone at this point, and the absence of the Millstone-grit, which is so largely developed close at hand, would indicate a great erosion of the Lower Carboniferous series before the deposition of the Permian. The Permian strata were here certainly deposited on nearly level Carboniferous Limestone; and if this were its original plane of deposition, the elevation, and probably the great dislocation, must have taken place between the Permian and the New Red period; also a second great erosion before the deposition of the New Red Sandstone. The Mountain-limestone, with its overlying Permian, must have been pitched up some 15° or 17° before the Bunter Sandstone was deposited against them, and then the whole further elevated to the extent of the present dip of the Bunter.

That a great denudation of the Lower Carboniferous series took place before the close of the Permian, is also evident from the large number of fragments of Mountain-limestone that occur in parts of the Permian breccia round the Abbersley Hills, and on the banks of the Avon, near Bristol.

From some facts I have recently observed in Flintshire and Denbighshire, I think the contour of the Mountain-limestone range of North Wales was not materially changed during the Glacial period; but that some further erosion did take place, is manifest from the abundant fragments of Mountain-limestone that occur in the Boulder-clay of the North Welsh coast. Ice-transported blocks of Mountain-limestone, weighing many hundredweights, and Mountain-limestone fossils also, frequently occur in the Drifts and Boulder-clay of the Severn Valley.—I am, &c. GEORGE MAW.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—Your Correspondent whose observations appear on page 236 of your Magazine for May falls into a serious error in supposing that the stratified and unfossiliferous clay, which appears upon the surface of the Lower Boulder-clay, at Heaton Mersey, near Manchester, belongs to the Upper Boulder-clay division. Yesterday I paid a visit to the locality, and, after comparing his notes with the sections that are now to be seen, it is evident that they are not the same sections as those mentioned by Mr. E. Hull, of the Geological Survey, but, on the contrary, are taken from a Brick-croft at a distance of about 300 yards, where nothing but Lower Boulder-clay is to be seen, with a covering of fine sand. The absence of the 'Laminated clays and bed of decomposed vegetation,' in Section No. 1, that your correspondent gives, is owing to its being at a much lower elevation than Section No. 2 that he speaks about, where he says that upon the surface (of what he calls Upper Boulder-clay) 'occurs a boggy soil, with branches of trees, some 3 feet thick.' The difference that exists between the Upper Boulder-clay and the deposit at Heaton Mersey, to which he gives the same name, is so great that a novice would be able to see the distinction. The first is a hard, compact, and unstratified deposit, containing pebbles and striated boulders in abundance; whilst the second is a soft stratified or laminated deposit in which no pebbles nor boulders occur. Another proof as to the difference of the deposit is well shown in the materials that are produced from them. The Boulder-clay is extensively used for brick-making, whilst the laminated clay is used for making earthenware. The following is the section about midway from the top of Grundy Hill; it was taken yesterday:—

Fine laminated sand	10 feet.
Layer of peaty matter, about 3 feet thick, composed of decomposed vegetation, containing branches of hazel-trees, trunks, and roots, but not in an upright position .	1 foot.
Dark-brown laminated clay, now known as 'warp'	13 feet.
Lower Boulder-clay, varying in colour from red to bluish, containing striated boulders and remains of *Bos primigenius* . .	20 feet, and the base not seen.

I may state, that I never before observed the trunks and roots of the hazel-trees in the bed that occurs on the surface of the 'warp,' nor was I ever rewarded with finding the remains of *Bos primigenius* in the Lower Boulder-clay of Heaton Mersey until my excursion yesterday.—Yours, &c. J. WEBSTER KIRKHAM.

LOWER BROUGHTON: *May* 5, 1865.

To the Editor of the GEOLOGICAL MAGAZINE.

DISCOVERY OF FOSSIL SHELLS IN THE SILURIAN SHALES OF DUMFRIESSHIRE.

SIR,—The precise age of the Silurian beds of Dumfriesshire has always been a difficulty with Geologists, because the most diligent search has hitherto brought to light no higher organisms than *Graptolites*, with the exception of some very doubtful and obscure specimens—so obscure that the species could not be determined.

It has been my good fortune to discover several specimens of shells in the Black Shales of Garpel Burn, which runs through a glen about 2½ miles from the town of Moffat. I only found them after searching the shales on four consecutive days, spending a good part of each day at this point. After finding the first specimens, I went on the following day; but, although I laboured for several hours, I did not succeed in obtaining a single specimen. On a subsequent occasion I was more fortunate, but yet the fossils are very rare. The state of preservation of these shells is pretty good, and they may be referred to two species: one is a Brachiopod, like *Discina rugata*, but rather larger than the one figured by Sir R. I. Murchison, in his 'Siluria.' This shell, in the typical district, ranges from the Wenlock to the Ludlow beds; and, according to this evidence, these beds must rank higher than has been hitherto supposed. The others may be referred to *Modiolopsis*, and the species much resembles *M. orbicularis*, which ranges from the Caradoc or Bala to the Llandovery Rocks. The occurrence of this shell seems to confirm the opinion held by Professor Harkness, that these beds are of the same age as the Caradoc Sandstone.

This discovery is of some importance, as it points towards data on which the age of the beds may be decided. I have therefore thought it my duty to lay it before the Geological world as soon as possible.

I am, Sir, &c., D. J. Brown.

North Bridge Street, Edinburgh.

MISCELLANEOUS.

Illustrations of Trilobites.—We have received from Mr. E. J. Hollier, of Dudley, a lithographic plate of Trilobites of the natural size, characteristic of the Wenlock Shale and Limestone of Dudley, drawn from specimens in Mr. Hollier's collection. There are 28 figures of various species, from the great *Homalonotus delphinocephalus* to the minute *Cyphaspis megalops.* But although interesting to local collectors, and also because they represent actual specimens, their execution is not equal to that of the figures given by Mr. J. W. Salter, in his monographs for the Palæontographical Society, and hardly does justice to the excellent specimens in Mr. Hollier's cabinet, which they are intended to represent.

OBITUARY.

Samuel P. Woodward, Ph.D., A.L.S., F.G.S., Assistant-Palæontologist in the British Museum, and Examiner in Natural Sciences to the Council of Military Education, was born September 17, 1821. He was the second son of the late Samuel Woodward, of Norwich, well known to geologists and antiquaries as the author of a 'Geology of Norfolk' (1833), 'Synoptical Table of British Organic Remains' (1830), a 'History of Norwich Castle' (posthumous, 1847), and various papers in the 'Archæologia' of the Society of Antiquaries. Shortly after his father's death, he was temporarily employed (in 1838) in the library of the British Museum, and in 1839 succeeded Mr. Searles Wood as Sub-curator of the Geological Society of London, and was elected a Member of the Botanical Society and an Associate of the Linnæan. In 1845, he was appointed Professor of Botany and Geology in the Royal Agricultural College, Cirencester, and was one of the founders of the Cotteswold Naturalists'

Field-club. In 1848 he was made first-class Assistant in the department of Geology and Mineralogy in the British Museum. He published but one independent work, a 'Manual of Recent and Fossil Shells,' of which the first part appeared in 1851, and the two following in 1853 and 1856. It has been used or recommended as a text-book by nearly every Professor of Natural History and of Geology in Great Britain; while in America it has obtained a very extensive circulation. The small Geological Map of England, published by the Society for the Diffusion of Useful Knowledge, was prepared in 1843 by Mr. Woodward, under the superintendence of Sir R. I. Murchison; and Professor Owen acknowledged his assistance in the Invertebrate portion of his 'Palæontology.' Dr. Woodward contributed several important papers to the 'Quarterly Journal of the Geological Society,' 'Proceedings of the Zoological Society,' 'Recreative Science,' 'Annals and Magazine of Natural History,' &c. The article 'Volcanoes' in the 'Encyclopædia Britannica,' the scientific reviews in the 'Critic' of 1860, and the 'Athenæum' reports of proceedings in the Geological Section of the British Association from 1841 to 1856, are amongst his minor contributions to Geological literature.

These Memoirs exhibit the vast acquaintance with the recent forms of Mollusca possessed by their author, and afford strong evidence of the philosophical cast of his mind, and his talent in determining the zoological relations of obscure organisms. One of his most remarkable achievements in this line of research was his determination of the true affinities of the extinct family of Rudistes, published in the 11th volume of the 'Quarterly Journal of the Geological Society;' and the Society showed its appreciation of the merits and value of his memoir on that subject by awarding him the proceeds of the Wollaston donation-fund in the year 1854; and again in 1857, on this account, and to assist him in his researches in the class Radiata.

He was a Member of the Council of the Geological Society from 1859, and had recently been appointed one of the Examiners in Geology and Palæontology to the University of London.

Although his published works may, for a man of his acknowledged merit and position in the scientific world, appear to be small, they represent only a portion of the original work that he performed: many of the results he arrived at must unhappily have died with him, but others remain in the form of carefully prepared manuscripts, which his brothers entertain the hope of publishing. It may be a matter of surprise that he did so little in making known the results of his investigations; but for the last twenty years of his life he suffered from chronic asthma, which eventually became so distressing as to awaken the sympathies of all, and caused many to marvel at the energy he displayed in research and conversation during intervals of release from pain.

An attack of acute bronchitis, which occasioned the rupture of an artery in the lungs, was the immediate cause of his death, at Herne Bay (whither he had gone in the hope of benefit to his health), on the 11th of July.

THE

GEOLOGICAL MAGAZINE.

No. XV.—SEPTEMBER 1865.

ORIGINAL ARTICLES.

I. THE CAMBRIAN ROCKS OF THE BRITISH ISLANDS, WITH ESPECIAL REFERENCE TO THE OCCURRENCE OF THIS FORMATION AND ITS FOSSILS IN IRELAND.

By WM. HELLIER BAILY, F.L.S., F.G.S., &c.,
Acting Palæontologist to the Geological Survey of Ireland.

THE term *Cambrian* (from Cambria, the ancient name of Wales) was originally employed by the Rev. Professor Sedgwick to include a great *series of* fossiliferous and other rocks occurring below the Bala Limestone in North Wales. Sir Charles Lyell * adopts to a certain extent this classification, dividing it into Upper and Lower Cambrian.

Sir R. I. Murchison alludes to this formation as the 'Cambrian or Basement Rocks of the Silurian Region,' † including under that designation those of the Longmynd Hills in Shropshire and their equivalents in North Wales. He explains his use of the term Cambrian to be 'as restricted by the late Sir H. de la Beche, and his associates of the Geological Survey, in applying it only to the lowest of these sedimentary rocks, which, like those of the Longmynd, underlie all the strata with Silurian fossils.' In accordance with this application of the term as being that generally adopted by geologists, I propose now to consider it.

The occurrence of Cambrian, and even perhaps Pre-Cambrian, or Laurentian, Rocks in Scotland appears to be well authenticated both by Sir R. I. Murchison and other observers; but the exact relations of the rocks believed to belong to these older formations in the north-west of Scotland and the Hebrides is at present undecided, and no fossils have yet been discovered in them.

The rocks of North Wales referred to the Cambrian formation, on the authority of the Geological Survey, exhibit between Harlech and Dolgelly, according to Mr. Alfred Selwyn, 8,000 feet of thick beds of quartz-rock, sandstone, and clay-slates, the lower part of the series not being observable; and in the section by Professor Ramsay, across the Menai Strait, and over Glyder Fawr, to the north of Snowdon, the upper 5,000 feet of the Cambrian series in that part of the country is described as consisting of green and purple slates, grits, sandstones, and conglomerates; the Penrhyn and Llanberis slate-quarries being worked in a band of slate at the upper part of the series.*

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* Manual of Elementary Geology (6th edit.), pp. 1, 6, [illegible], &c.

† Siluria (3rd edit.), p. 21, &c.

With respect to the occurrence of organic remains, the author of 'Siluria' observes, 'No fossils except marine plants or fucoids have yet been detected in these rocks of North Wales.'†

The Cambrian rocks of the Longmynds are described by the same eminent geologist as a range of round-backed hills flanking the western side of the road from Ludlow to Shrewsbury, and rising to heights varying from 1,400 to 1,600 feet, ranging from NNE. to SSW.; they stand boldly out from beneath the surrounding Silurian deposits, of which they form the mineral axis, the lowest beds being schists or clay-slates, with minute layers of silicious limestone, interrupted by bosses of eruptive trap-rocks, and overlain by a vast and regular series of hard purple or greenish and grey schistose flagstones and silicious grits, often finely laminated, on which the rippled surfaces are distinctly visible.‡

The thickness of this great series of strata is estimated by Mr. W. T. Aveline, of the Geological Survey, at more than 20,000 feet.§

Traces of organic life, although obscure, have been discovered in some of the fine-grained sandstones and shales of these ancient deposits by Mr. J. W. Salter, who describes them‖ as consisting of the impressions or surface-holes and burrows of Annelides of, he thinks, two species, which he names *Arenicolites didyma* and *A. sparsus*: these he believes to have burrowed in sand like the Lob-worm (*Arenicola*) of the present day, mentioning their occurrence as being in the greatest profusion and distinctly in pairs, indicating the exit and entrance holes to the burrows. That palæontologist also describes broad undulations, which he considers to be wave-marks, such as may now be seen on the sea-shore, and smaller and finer ridges or rippled surfaces, which, according to his views, may either represent the quiet action of the surf on a level strand, or the agitation of the water by wind. Certain rounded markings scattered numerously over the surfaces of some of the rippled and other slabs he believes to be impressions from rain-drops; and other markings also of frequent occurrence on the fine sandstones he describes as 'sun-cracks' or 'sun-dried surfaces,' the effect of the sun's heat upon the ancient mud. What he supposed to be the fragment of a Trilobite, or allied Crustacean, and described under the name of *Palæopyge*, appears to want that definition of character which would entitle it to be considered as of organic origin: we still have, however, in these the most ancient of the fossiliferous rocks, good evidence of the existence of organic life, and that not of the lowest type.

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* J. B. Jukes, Student's Manual of Geology (1862), pp. 435, 436.

† Siluria (2nd edit.), p. 27.

‡ *Ibid.*, pp. 22, 23.

§ See sheets 34 and 36, Horizontal Sections of the Geological Survey of Great Britain.

‖ Quart. Journ. Geol. Soc. of Lond., vol. xii. p. 248 (1856), and vol. xiii. p. 206 (1857).

In Ireland, rocks referred to the same series as those of North Wales occur immediately opposite Anglesea and Caernarvon, at the Hill of Howth near Dublin, Bray Head and other places in the northern part of the county of Wicklow, as well as a large district which includes the Forth Mountain in South Wexford. These rocks consist of a great series of sandstones or gritstones and slates, often interstratified with large masses and veins of quartz-rock.*

At the promontory of Howth, in the county of Dublin, the Cambrian rocks extend over a small area of only about two miles, consisting of large masses of quartz-rock, interstratified with green grits and green and purple slates; the beds being often highly inclined, contorted, and so confused that it is impossible to make out any continuous section.† Only very faint traces of organic life have been met with at this place; and for these we are indebted to the perseverance and untiring zeal of the late Dr. J. R. Kinahan, a young naturalist of great promise, whose loss has been severely felt amongst scientific men in Ireland. The specimens he discovered and presented to the Geological Survey are included amongst their collection of fossils in the Museum of Irish Industry, Dublin, and afford (although few in number) tolerably good evidence of the occurrence of that remarkably characteristic fossil of the Irish Cambrians, the *Oldhamia*, so abundant at Bray Head, in the county of Wicklow, and hereafter alluded to. These specimens, and another since collected by Mr. C. Galvan, of the Geological Survey, appear to be correctly referred to *O. antiqua*: the impressions are, however, somewhat indistinct and sparingly distributed. The beds from which they were obtained are situated on the north shore, at what is called Puck's Rocks, and are composed of a yellowish slate, readily splitting into fine laminæ, very similar to the brown laminated schists of Carrick Mountain, in the county of Wicklow (hereafter alluded to), which are often covered by impressions of the same species of *Oldhamia* in much better preservation.

From beds immediately overlying those containing the *Oldhamia*, Dr. Kinahan also procured slabs with tortuous markings like tracks.

On consulting the maps of the Geological Survey of Ireland,‡ it will be seen that the Cambrian district of North Wicklow commences about two miles north of the town of Bray, extending southwards to

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* For a description of the geology of this district, see a memoir by Messrs. Jukes and Haughton, 'On the Lower Palæozoic Rocks of the South-east of Ireland,' Trans. Royal Irish Academy, vol. xxiii. p. 563, &c. (1859).

† *Vide* sheets 112 of the one-inch scale, Maps of the Geological Survey of Ireland, and Explanations to sheets 102 and 112 (1861).

‡ Sheets 121 and 130.

Wicklow, a distance of about seventeen miles, with a breadth of about seven miles at its widest part. It includes masses of quartz-rock, which contribute much to the beauty of the scenery, and form the most elevated peaks, such as those of the Great and Little Sugarloaf Mountains, the former being 1,659 and the latter 1,120 feet in height.

There are two small slightly detached districts in North Wicklow, that nearest Dublin, at Shankill, being about one mile and a half long, following the direction of the granite axis N. and SW., and about the third of a mile broad at its widest part. A hill of quartz-rock called Carrickgolligan rises from it to an elevation of 912 feet. No fossils have yet been detected within this area.

The other, a larger and more important district, on account of its fossils, is situated to the south-east, near Rathdrum, and about five miles south-west of Wicklow; it is six miles long and nearly one broad at its widest part, including masses of quartz-rock; and rising to a height of 1,260 feet, it forms Carrick Mountain, some of the shales upon which, easily separating into laminæ, are seen to be covered with very distinct impressions of ***Oldhamia antiqua***: there are also tracks and burrows of Annelids in the sandy beds, amongst them some with double openings like ***Arenicolites didyma***, Salter.

Occupying a considerably larger area than either of these is the Wexford Cambrian District, which extends from the east point of Bannow Bay, about four miles east of Waterford Harbour, to Roney Point, six miles north of Wexford, having a total length of thirty-six miles and a breadth of about seven miles at its widest part, near Wexford. No fossils have yet been discovered in this district.

It is, however, to the rocks at Bray Head and the neighbourhood, we would direct the attention of those who are desirous of studying this series of deposits in connection with the interesting fossils they contain, as they are here found in the greatest abundance, and may be regarded as examples of the most ancient forms of life with which we are acquainted.*

The rapidly improving sea-side town of Bray, twelve miles south of Dublin, may be reached by either of two lines of railway, which converge before entering the town. That through Kingstown, starting from the Dublin terminus in Westland Row, skirts the south coast of the beautiful Bay of Dublin; the other and most direct route being by the Dublin, Wicklow, and Wexford Railway from the terminus in Harcourt Street. In either case these railways commence in the Upper Carboniferous Limestone, upon which Dublin is built, continuing to run for about four miles over that formation. They then enter the boundary of the great granite-area, which is the largest display of that rock on the surface in the British Islands, crossing it at its northern extremity,—in one case, between two and three miles from the coast, for a distance of nearly six miles—in the other, following to some extent the curvature of the coast to Kingstown, celebrated for its fine harbour, then proceeding about half a mile inland, until it again reaches the sea opposite the southern extremity of Dalkey Island, a distance of nearly five miles, where it enters upon the comparatively narrow belt of metamorphic rocks which flank the granite-axis, and forms the commencement of the Lower or Cambro-Silurian formation. These rocks continue for about another mile to the south side of Killiney Bay, where is believed to be the commencement of the Cambrian district of North Wicklow, about a mile north of the town of Bray; the shore and interior of the country, up to a certain height on the flanks of the hills,

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* This conclusion does not appear to me to be affected by the reputed discovery by the Geological Survey of Canada, as announced by Sir William Logan, the Director, at the last meeting of the British Association, of a fossil named *Eozoön Canadense*, referred by Dr. Dawson to the group of Foraminifera, and said to be from rocks below the Cambrians, in strata of the Laurentian series (alluded to in former numbers of this Magazine, viz., No. 1, p. 47; No. 5, p. 205 &c.; and No. 7 of vol. ii. p. 3 &c.). The specimens exhibited on that occasion I had the opportunity of examining before the meeting; and from that inspection and subsequent observation I feel considerable doubt as to its being an organic structure, and still more as to *Eozoön* belonging to so high a group as that of the *Foraminifera*; for, supposing it could be satisfactorily proved to be a fossil, its alliance would rather seem to have been with the Protozoa, or Sponges. It struck me, however, as being nothing more than a peculiar mechanical condition of the rock; which was a variety of serpentine, a mineral known to be of aqueous origin, and to be for the most part composed of the débris of other rocks; and, from the mode of its deposit, often exhibiting, when polished, wavy or contorted laminæ, and having occasionally a vesicular or irregularly cellular appearance, such as these specimens of Canadian Serpentine appeared to me to show.

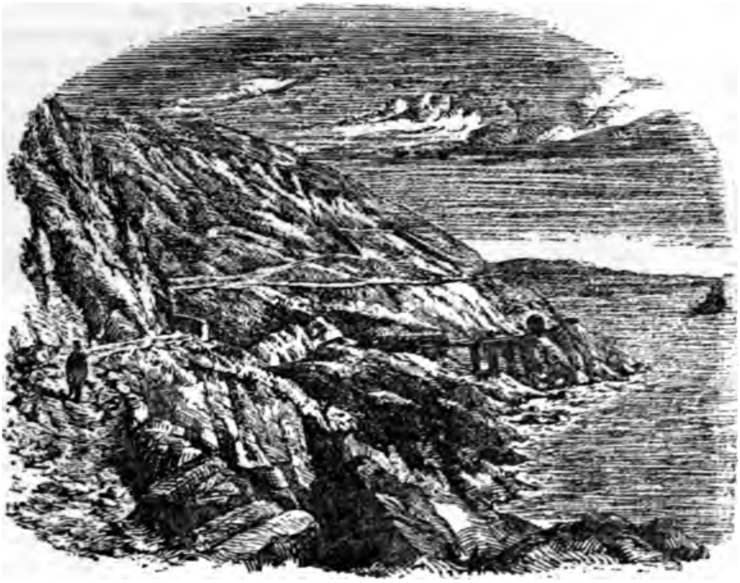

FIG. 1.—BRAY HEAD, WICKLOW. (Looking North.)

being covered with drift of sand and gravel, so as to conceal the underlying rocks.*

From the Bray Railway station, a walk along the shore of about a mile brings us to the commencement of the series of rocks forming the bold and picturesque promontory of Bray Head, which rises in sombre majesty from the sea to a height of nearly 800 feet. The railway is continued through this apparently impenetrable mass of rocks by several short tunnels and cuttings, passing over the chasms by bridges or viaducts, and aiding the geologist, as it generally does, by exposing fine sections of the strata, exhibiting occasional breaks or *faults* in its continuity, and the variety of inclination or *dip*, curvature or contortion, to which the beds have been subjected, as well as adding considerably to the picturesque effect of this prominent part of the coast when observed from the sea.

The sketch on the preceding page (fig. 1) may serve to give some idea of the appearance these rocks present, with the general configuration of the hill towards the sea.

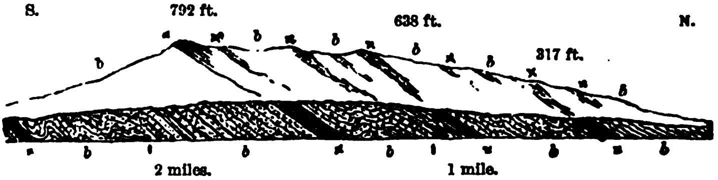

FIG. 2. DIAGRAMMATIC SECTION OF THE CAMBRIAN ROCKS AT BRAY HEAD.

* Quartz Rock. *b*. Cambrian grits and slates.
(General dip, about 45° to 80° NE. Horizontal scale, about 1½ inches to the mile; vertical scale, twice that of the horizontal.)

A diagrammatic section of this part of the coast is given above (fig. 2), showing in a rough way the general dip of the strata with their convolutions, and the interpolation of irregular masses of quartz, on a scale (horizontally) of about one and a half inches to the mile, the vertical scale being twice that of the horizontal. The beds, consisting of green and purple grits and slates, mostly dip towards the NE., at a high angle, varying from 45° to 80°, are often much contorted, and occasionally interstratified with veins and masses of white and yellowish quartz. This rock forms the most prominent parts of the hill, and some of the beds may be traced down to the section exposed on the shore (they are represented in fig. 2, at *, by crossed lines). It is in these grits and slates, at several places along this part of the coast, that the remarkable little branching or plant-like fossils called *Oldhamia*, before alluded to, have been met with, sometimes occurring in great profusion, although they have never yet been found in England or Wales.

In walking along the shore from Bray towards the Head, the first rocks containing these fossils accessible at low water are what are called the Periwinkle Rocks, consisting of a greenish fine-grained grit with irregular joints crossing the numerous layers of deposit. On striking off a piece of this rock, it will be seen to exhibit a wrinkled appearance; and, on closer inspection, this will be found to have been caused by numerous irregular star-like markings radiating from a centre, which preserve a certain amount of uniformity, and appear to permeate the whole mass of rock, every one of the numerous laminæ, where exposed, exhibiting a surface covered by these peculiar little fossils. The above wood-engraving (fig. 3) gives a representation of the appearance presented by a fragment of rock full of these characteristic fossils. This, the most abundant species, which is found at several other stations in these cliffs, has been named *Oldhamia radiata*.

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* *Vide* sheet 121, one-inch scale, Maps of the Geological Survey of Ireland.

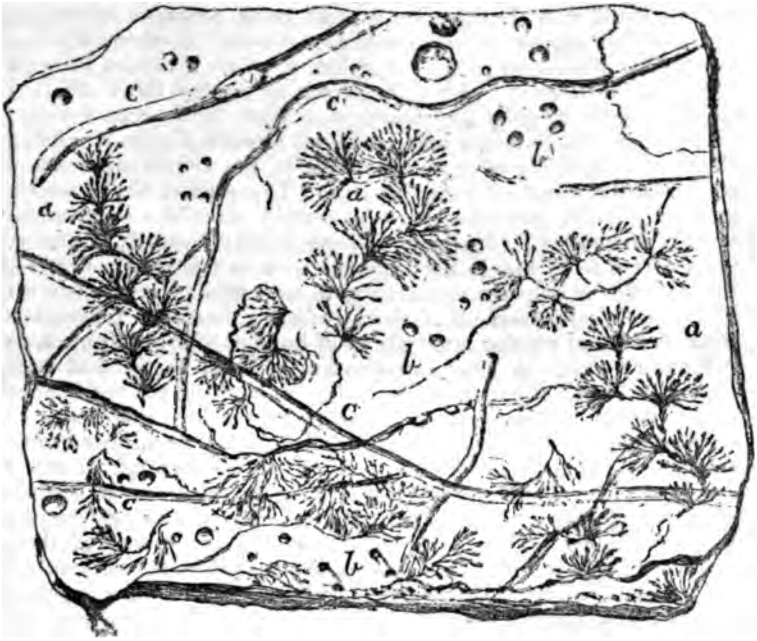

FIG. 3.

Oldhamia antiqua (*a*) with burrows of Annelids, *Arenicolites didyma* (*b*), and surface-tracks (*c*).
CAMBRIAN GREEN SHALES, BRAY HEAD, COUNTY OF WICKLOW.

A second species, called *Oldhamia antiqua*, occurring, like the former, in both green and purple shales and grits, has been also met with at various places along the shore, as well as in the rocks exposed on the side of the hill; but the two kinds seldom if ever occur together in the same bed. The latter species, consisting of an assemblage of fan-shaped rays, arranged in alternating series, is shown at fig. 4, p. 394.

The first published account of these fossils was given by Dr. Thomas Oldham, then Curator of the Geological Society of Dublin, and Professor of Geology in Trinity College (now Superintendent of the Geological Survey of India), who, with the keen discernment of a naturalist, saw in them something more than mere markings; and, in a paper read before the Geological Society of Dublin, 'On the Rocks at Bray Head,'* observed, 'that he had not as yet been successful in finding organic remains in the slate-rocks of Bray Head, *with the exception of some small zoophytic markings*, which did not appear referable to known genera.' Some years afterwards, that eminently gifted naturalist, the late Professor Edward Forbes, when Palæontologist to the Geological Survey, threw still further light upon them by a communication made to the same Society, entitled '*On Oldhamia*, a new genus of Silurian Fossils.'† After alluding to the rarity of organic remains in the Cambrian or oldest portion of the Silurian strata, he says, 'The earliest fossils which have yet been discovered seem to be certain plant-like impressions or casts discovered by Professor Oldham at Bray Head, in Wicklow, and referred to by him in his communication to this Society in 1844. These bodies present the appearance, in most specimens, of a central filiform axis, with fasciculi of short radiating branches proceeding from its sides at regular intervals, or of bundles of such filiform rays without an axis. A close examination of them shows that each branch is formed of a series of articulations marking the positions of minute cells. The entire body presents a striking resemblance to the arrangement of parts in certain Zoophytes, as in *Sertularia cupressina*, but are also consistent with those exhibited in many *Bryozoa*, as in *Gemellaria* and *Cellaria*, an alliance more in accordance with the minute structure.' He also observes, 'I propose the name *Oldhamia* for these remarkable fossils, in honour of their discoverer, who has in them made us acquainted with what in all probability is a group of *Ascidian Zoophytes*, or rather, compound *Tunicated Molluscs*, in stratified rocks of very early date, and has thus furnished an additional and important fact in contradiction of the crude notion that the earliest forms of animals are the most rudimentary.'

No further details respecting these fossils were published, or figures of any consequence given, until the late Dr. J. R. Kinahan, a young naturalist of great ability, directed his attention to the investigation of rocks ascribed to the Cambrian formation in Ireland; his perseverance and zeal being rewarded by the discovery of the *Oldhamia* in the cliffs of Howth, county of Dublin, and the recording of several additional stations for it in those of Bray Head and Greystones, county of Wicklow, where he collected more distinct and perfect specimens, and obtained some other forms of animal remains. These additions to the Cambrian fauna he described in papers read before the Geological Society of Dublin, and published in their Proceedings.*

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* Journ. Geol. Soc of Dublin, vol. iii. p. 60 (1844).
† *Ibid.*, vol. iv. p. 20 (1848).

That much-lamented gentleman, in his frequent search amongst these hard and apparently unyielding grits, obtained better specimens of the *Oldhamia* than those examined by the late Professor Forbes; so that he was enabled to write an elaborate treatise, with descriptions of the different forms assumed by the genus, illustrated by excellent woodcuts, which was published in the Transactions of the Royal Irish Academy.† In that treatise, presuming that Professor Forbes's leaning was towards their alliance with the Polyzoan Molluscoids, he professes to dissent from that view of their relations, expressing his opinion 'that they were more probably the polypidoms of extinct *Hydrozoa*, than cœnicia of *Polyzoa*' (p. 561). It will be seen, however, that he only reiterates the opinion of Professor Forbes, as the descriptive card, in Professor Forbes's own handwriting, which was attached to the specimens in the Geological Survey Collection (Museum of Irish Industry), of which the following is an exact copy, will testify :—'*Oldhamia* (Forbes). The most ancient fossils yet discovered : believed to be the remains of marine animals belonging either to *Hydrozoa* (Corals) or *Polyzoa* (Compound Mollusca).'

In his paper, Dr. Kinahan supplies scientific descriptions of the species named *Oldhamia antiqua* and *O. radiata* by Professor Forbes, and, in addition, describes what he considers to be a third species, under the name of *O. discreta*, from Carrick Mountain, a locality from which some of the most distinct specimens of *O. antiqua* were obtained, of which species I believe this to be merely a variety.

There remain, then, only the two well-marked species, originally named by Professor Forbes *Oldhamia antiqua* and *O. radiata*. The first of these, *O. antiqua*, is most frequent in the shales, and occurs as clearly defined impressions in beds of either a red or green colour at Bray, and in the brown and purple shales of Carrick Mountain, county of Wicklow, and less distinctly and more rarely in the brown laminated shales of the northern coast of the peninsula of Howth, in the county of Dublin. This species is less abundant than *O radiata*, and does not occur in dense masses like the latter, but usually as isolated and distinct branches scattered over the surface of the beds. It is more uniform in character than *O. radiata*, as, instead of radiating from a centre like that species, the branchlets are fan-shaped, and arranged in an alternating manner at regular distances upon a zigzag axis. Fig. 4, *a*, is a representation of this species, showing several branches of different sizes, as impressed upon a slab of green fine-grained laminated shale from Bray Head :

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* 'On Anneloid Tracks in the Rocks of Bray Head,' Journ. Geol. Soc. Dublin, vol. vii. p. 184, pl. 5, figs. 1–5; and 'On the Zoological Relations of Bray Head and Howth, with an Account of the Fossils of Irish Cambria,' Journ. Geol. Soc. Dublin, vol. viii. p. 68, pl. 7, figs. 1, 2.

† 'The Genus *Oldhamia*, its Characters, &c.,' Trans. Roy. Irish Academy, vol. xxiii. (1858).

on the same surface of this thin bed are horizontal tracks of various sizes and burrows of *Arenicolites*, with double openings resembling *A. didyma*, represented on the same figure at *b.**

Varieties of this species occasionally accompany the ordinary form, particularly in the shales of Carrick Mountain. In some of these, the fans of branchlets are more closely arranged upon the axis, and are more wavy and intermittent, the fasciculi being denser: this is the variety (before alluded to) which was believed by Dr. Kinahan to constitute a third species, and to which he applied the name of *O. discreta* (fig. 5, *a*). Another and more attenuated form is generally present on the opposite side of the same slabs: in this, the fans of branchlets are less dense, and appear to be drawn out of shape, probably by the effects of cleavage (fig. 5, *b*). The specimens of *Oldhamia antiqua* from this locality occur in brown and buff-coloured shales, easily separating and more argillaceous than those of Bray.

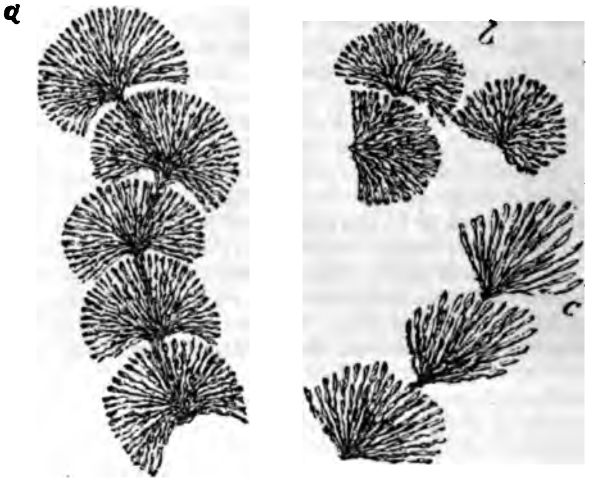

FIG. 4.—OLDHAMIA ANTIQUA, FORBES, CAMBRIAN, CARRICK MOUNTAIN, COUNTY OF WICKLOW.
a. Ordinary form at this locality. *b.* Var. (*O. discreta*, Kinahan).
c. Elongated variety. All natural size.

The localities for this species are various stations in the rocks of Bray Head and Carrick Mountain, county of Wicklow, and Howth, county of Dublin, in beds generally distinct from those containing *O. radiata*; although Dr. Kinahan remarks that scattered forms of *O. antiqua* sometimes occur, though rarely, in the beds of *O. radiata*.

The second species, *Oldhamia radiata*, is the most abundant one in the rocks of Bray Head; and at Greystones, on the coast, four miles farther south, it occurs in a precisely similar rock to that called the Periwinkle Rock of Bray Head, and was the only species observed by me at that locality. Dr. Kinahan has evidently mistaken it for *O. antiqua*, the figures he gives under that name in the paper before quoted (figs. 9 and 10, p. 559) being unquestionably those of *O. radiata*. It has not been observed at Howth, Carrick Mountain, or any other locality than the two I have mentioned. The most ordinary form is that shown in the woodcut, fig. 3, *a*, p. 391.

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* I have noticed similar double markings occurring on some of the fine-grained laminated grits at Carrick Mountain. From the same locality was also procured a large worm-cast resembling those of the *Histioderma*.—W. H. B.

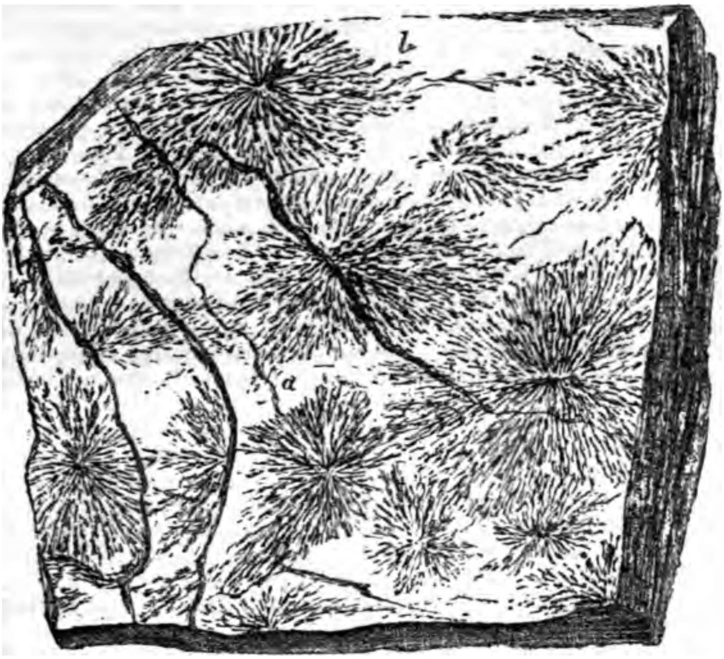

FIG. 5.—OLDHAMIA RADIATA, FORBES, SHOWING SUCCESSIVE LAYERS.
a. Ordinary form. *b.* Plumose variety.
Cambrian (green grit) Periwinkle Rocks, Bray Head, County of Wicklow.

The general appearance presented by this species is that of a stellariform mass of filaments or branchlets, of variable length, which often divide into two, becoming wavy and intermittent, or jointed, all the separate tufts radiating from a central point or axis.

The star-like form is more or less complete in consequence of the variable length of the branchlets: sometimes one or more of these are very much elongated, giving the fossil a more plumose appearance, as shown on fig. 3, at *b*.

The principal, and, I believe, only localities for this species, are those of Bray Head and Greystones, county of Wicklow, at both of which places it is met with in the greatest profusion, occurring sometimes as a dense and matted mass, which appears to permeate the rock in every direction where fractured, and to spread over the surface of the numerous beds in successive layers. The beds which contain it are sometimes several feet thick, and generally harder and more compact than those in which *O. antiqua* are found; they occur in either purple or green grits, most frequently perhaps in the latter, and on separating the laminæ the fossils are seen to be slightly in relief on one surface, whilst the opposite bears a corresponding indentation.

Some difference of opinion has been expressed, more particularly by men of science in other countries, as to whether these fossils should properly be referred to the animal or vegetable kingdom; some Continental writers having figured and described them as fossil plants—others again have even doubted their being organic at all, considering them merely to be markings caused by a peculiar mechanical condition of the rock. By the majority of Palæontologists in this country, their zoological affinity appears to be accepted, in accordance with the eminent men who have published their views as to the animal origin of these fossils; and, considering them in the same light, their alliance with the Sertularian Zoophytes—which they resemble so closely—as first suggested by the late Professor Edward Forbes, appears to be the most reasonable conclusion as to their relationship we can arrive at. On the other hand, their resemblance to certain jointed marine plants, such as the lime-secreting *Nullipores*, would incline us to hesitate before pronouncing with certainty as to their animal origin. As to their being organic, and not a mere mineral condition of the rock, there can, I think, be no question, because we find the representatives of each species, although often varying in shape and size, presenting the same general definite characters, notwithstanding their being isolated from each other; and although sometimes appearing to form an homogeneous mass permeating the rock, yet the surfaces of the beds show them to be deposited in horizontal layers between those surfaces, consisting occasionally of a few scattered examples, at other times of a more or less matted assemblage.

The articulated character of the branchlets, which was considered by Professor Forbes to indicate the position of minute cells, and the presumed discovery by Dr. Kinahan of 'reproductive cells,' do not appear to me to be satisfactorily established, as, after an examination of the original and a number of other specimens, the only conclusion I can arrive at being that the jointed appearance they often exhibit is analogous to the structure presented by the *Nullipores*, or lime-secreting plants, before alluded to.

That there is a general similarity of *Oldhamia antiqua* to certain recent *Hydroid Polypes* (popularly known as Corallines), such as the arborescent forms of *Sertularia cupressina* and *argentea*,* is very evident, both of these species or varieties being abundant at the present day on the same (east) coast of Ireland. To the former—*S. cupressina*—it is said by Professor Forbes to present a striking resemblance, whilst Dr. Kinahan considers its nearest comparison to be with *S. argentea*: either of which conclusions may be correct, when we consider the probability of their being merely varieties of one species; a question upon which Dr. Johnston makes the following remark: 'Pallas thinks they constitute but one species, his *cupressina*.' *

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* For excellent figures and descriptions of both these varieties, see Johnston's 'British Zoophytes,' pl. 15 and 16, vol. ii. pp. 79, 80; vol. i. pl. 14, fig. 3, and 15 and 16, vol. ii.

No comparison having hitherto been made known between *Oldhamia radiata* and any living forms, I have endeavoured to trace out its nearest alliance, in accordance with the views of Professor Forbes, as to the probability of its being related to the *Sertulariadæ*, and find this species bears a considerable resemblance to some of the frondose or bushy examples of that family, particularly to *Cellularia plumosa*, which is said by Dr. Johnston 'in habit to be something like *S. argentea*' (a species previously alluded to as comparable with *O. antiqua*): the fossil is, however, more tufted and bushy, although not very unlike in form what we may suppose such a recent species would assume if spread out and subjected to pressure, as these fossils must have been.

With reference to the remark made by Dr. Kinahan, 'that it is questionable whether it would not be more convenient to place these two kinds of *Oldhamia* under separate genera,' † I would observe that, in the absence of any satisfactory evidence as to the presence of reproductive organs, we can, I think, only consider them as being specifically and not generically distinct; for although differing in the mode of arrangement of their parts, they appear to be sufficiently alike in general character to justify our retaining them under the same generic appellation. The specific distinction is also supported by the difference in the condition of the deposit in which the two kinds occur; *O. antiqua* being most frequently met with in the softer or shaly beds, whilst *O. radiata* is abundant in the more compact and gritty beds, the two species, as before observed, being seldom if ever found together.

Accompanying the *Oldhamia*, at all the localities mentioned, are unmistakeable evidences of other marine animal life, in the numerous tracks and burrows often found intermixed with them in the same beds, and sometimes occurring in distinct ones in their immediate neighbourhood.

These tracks are of various forms and sizes; some of them nearly straight, some slightly curved, and others more or less tortuous, resembling very much those produced by sea-worms belonging to the *Annelida* on sandy shores at the present day. Some of them occur in pairs of double openings, the tubes from which pass vertically through the beds; they appear to be identical with those from the Longmynds described by Mr. Salter, and named by him *Arenicolites didyma*. These double orifices, fig. 4, *b*, are seen to be intermixed with *Oldhamia antiqua*, and tracks of large and smaller diameter (*c*) proceeding in a horizontal direction on the same surface.

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* British Zoophytes, vol. i. p. 341, and pl. 16, fig. 1.

† Treatise on *Oldhamia*, p. 551.

Tubular markings of a larger size and tortuous form, usually found in distinct beds of a coarser and more sandy character, have been referred to Mollusca by Dr. Kinahan.[*] In the absence, however, of any more certain evidence of the existence of this important class during the Cambrian period, such as their fossil shells would present, we cannot, I think, do otherwise than refer them with the other tracks to the class *Annelida*.

To the late Dr. Kinahan's perseverance we are indebted for the discovery of a fossil he has described under the name of ***Histioderma Hibernicum***.[†] Several examples of the large tubular casts of this fossil, which he considers to have been an Annelidan worm, were obtained by him from the compact greenish grits overlying the Oldhamia-beds of Bray Head and Greystones. Their appearance on the surface of the beds is that of a slightly raised mound of about one inch and a half in diameter, having a depression in the centre forming the orifice. These tubular burrows pass vertically through the bed for a distance of about one and a half to three inches, gradually decreasing in size, and slightly curving; they terminate by a rounded extremity which turns upwards, assuming a kind of trumpet-shape, the cast of its upper portion being marked by several ridges crossing each other at irregular distances, as represented in fig. 6, which is reduced. Dr. Kinahan describes this fossil as 'a tentacled sea-

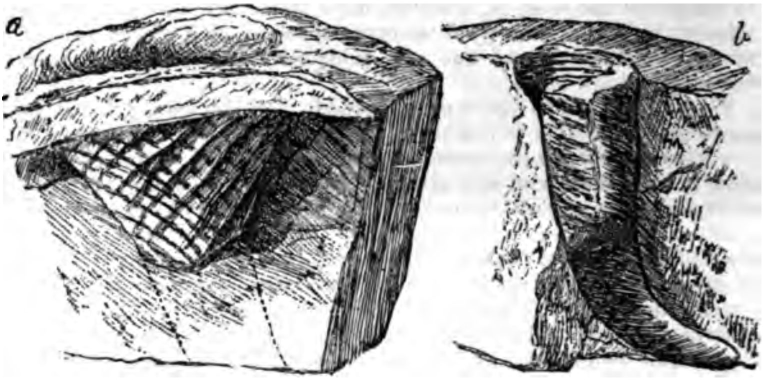

FIG. 6.—HISTIODERMA HIBERNICUM, KINAHAN, NAT. SIZE.
a. Opening of burrow and commencement of tube.
b. Lower portion, or curved extremity.
Cambrian (green grits), Bray Head, County of Wicklow.

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[*] Journ. Geol. Soc. Dublin, vol. vii. p. 184, pl. 5, figs. 1–5; and Trans. Royal Irish Academy, vol. xxiii. p. 56.

[†] Journ. Geol. Soc. Dublin, vol. viii. p. 71.

worm, evidently cephalo-branchiate, and not very dissimilar from the common Lug-worm (*Arenicola*) of our present seas.

The same author also collected and described* what he believed to be another addition to the Cambrian fauna, under the name of *Haughtonia pœcila*, but in which, as he states, 'the organic character is not so evident or satisfactory:' he supposes it to be the 'traces of an aggregation of tubes constructed by gregarious tubicolous worms belonging to the *Annelida*, and allied to *Sabella*.' It was found by him on the upper surface of a coarse reddish grit near the 'Periwinkle Rocks' of Bray Head, and shows a peculiar and regularly mottled appearance; what he supposes to be the tubes are white, and the interspaces red, and a vertical section exhibits a series of these tubes filled up with sand. The author, in acknowledging the difficulty of establishing the claims of such mere traces to be considered as fossils, expresses himself as follows,—upon 'the importance of recording every organic trace which tends to throw a light on the habits of the animals which lived at so early a period of the world's history as the Cambrian;' an observation with which I fully concur: at the same time, I must confess, I do not consider the specimen sufficiently definite, as to its organic nature, to warrant its receiving a name or being included amongst the fossils of the Cambrian formation.

In concluding these remarks, which are merely intended as a sketch of all that is at present known respecting the value of the fossil-evidence derived from the large masses of stratified rocks known in the British Islands as the Cambrian formation, it will have been seen that the only reliable proof of the remains of organic life is furnished by strata, referred to this series, in Shropshire and the South-east of Ireland; the former yielding merely tracks and burrows of marine animals, probably Annelids; the latter, a more varied and important assemblage, consisting of those well-marked and characteristic forms of *Oldhamia* believed to be the remains of zoophytic animals, and similar Tracks and Burrows to those found in the rocks of the Longmynds, with the addition of a large tubæform cast called *Histioderma*, resembling that of an Anneloid worm.

Some of the finer grits and more argillaceous beds, like those of the Longmynds, often display ridged and wrinkled surfaces, such as may be seen on the sea-shore at the present day, and which were probably due to the same causes, namely, the quiet action of the advancing or receding wave, or the agitation of the water by wind over a shallow shore.

From these results of the labours of investigators as to the Fossils of the Cambrian Rocks, we get tangible evidence of the existence of marine forms of life bearing a considerable resemblance to those of the present day, although the variety we are at present acquainted with is small. There may, possibly, as suggested by other writers, have been a more varied assemblage, including marine plants, and some of the softer kinds of Zoophytes, Mollusca, or other Invertebrate

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* Journ. Geol. Soc Dublin, vol. viii. p. 116.

Animals, of which no record remains, either from the perishable nature of their structures, or from their obliteration during the process of change or consolidation of the deposit in which they were embedded, whether chemically or otherwise. This, however, is merely conjectural, and must not be allowed, in the absence of facts, to exercise any influence upon our opinion with regard to the value of the fossil evidence which *has* been obtained from the series of strata now under consideration.

And here I may be excused pausing to reflect with admiration upon the remarkably perfect manner in which the fossils of these and other ancient rocks are preserved for our inspection and study by the covering up or superposition of one layer upon another; and although this assemblage occurs only as casts or impressions, the original organic substance having disappeared, we have disclosed to our view, with the greatest distinctness, tracks and markings of the delicate and fragile animals which then existed, accompanied by traces of phænomena of a similar character to those of our own times.

The importance of such imperishable monuments of the past cannot be too highly estimated, as by their study we get an insight into the conditions which prevailed during these remote periods of the world's history; and although we do not presume to assert that fossils may not eventually be discovered in strata of Pre-Cambrian age —until that is satisfactorily established (which does not appear to be the case at present), we maintain that this assemblage of fossils from the Cambrians is still entitled to be looked upon as the most ancient evidence of organic life with which we are acquainted.

NOTE.—For detailed descriptions of *Eozoön Canadense*, and the evidence upon which it is asserted to be an organic structure, see the two very excellent papers by Dr. W. B. Carpenter, F.R.S., and Prof. T. Rupert Jones, F.G.S.; the former of which appeared in the 'Intellectual Observer,' vol. vii. p. 278, and the latter in the 'Popular Science Review' for April 1865. Both these papers are beaufully illustrated.—EDIT.

AN EXTINCT GIGANTIC ARMADILLO.—There has just been added to the National Collection in the British Museum, plaster casts of an entire carapace with the tail attached, and portions of the skeleton, of one of the extinct gigantic Armadillos from South America. The original is preserved in the Museum at Dijon, France, and was described by L. Nodor (*Compt. Rend.*, 1855, xli. 335–338), and named *Schistopleurum* (*Glyptodon*, Owen) *typus*. The carapace and tail united are 8 feet in length, the carapace 3 feet high. It was found in the Pampas of Buenos Ayres.—W. D.

II. ON SOME CRUSTACEAN TEETH FROM THE CARBONIFEROUS AND UPPER LUDLOW ROCKS OF SCOTLAND.

By HENRY WOODWARD, F.G.S., F.Z.S.

(PLATE XI.)

I HAVE lately received, from Mr. James Armstrong of Glasgow, some very beautiful examples of the detached teeth of *Dithyrocaris* from Lanarkshire and Renfrewshire, and also specimens of *Ceratiocaris* from Lesmahagow (the latter collected by Mr. J. Slimon); and they seem to possess so much interest, that a description of them will doubtless be welcome.

So long ago as 1843, the late General Portlock (at that time a Captain of Royal Engineers conducting the Geological Branch of the Ordnance Survey of Ireland), in his Report on the Geology of the County of Londonderry, figured the teeth of *Dithyrocaris* in pl. xii. fig. 6, of that work; and at p. 315 he observes, 'Fig. 6 represents bodies which are frequently found on the specimens of this crustacean, and in this instance together, as represented in the figured specimen; they each exhibit a single row of tubercles, and were in all probability connected with the masticatory apparatus, which it is probable, therefore, was highly developed in this large species.' We reproduce the figure in our plate (Pl. XI. fig. 8).

Mr. Salter first noticed the teeth of *Ceratiocaris* in 1860,* but they have never been properly figured, nor does the figure of the teeth of *Dithyrocaris* from Ireland, given by Portlock (see Pl. XI. fig. 8), correctly represent these organs.

Plate XI. fig. 1, represents a perfect carapace of *Ceratiocaris*, at the anterior end of which (at *a*) the two opposing mandibles may be seen in their proper place, compressed on the surface of the left valve. A detached mandible (fig. 2) from the same locality as fig. 1 (Upper Ludlow Rock, Lesmahagow, Lanarkshire) is represented in the plate of the natural size.† Figs. 3–6 represent the teeth of *Dithyrocaris* collected by Mr. James Armstrong and Mr. J. Bennie from Campsie and East Kilbride, Lanarkshire, and Orchard Quarry, near Thornliebank, Renfrewshire.

Mr. Armstrong (being a practical geologist) was not satisfied with General Portlock's opinion that these detached teeth belonged to *Dithyrocaris*, especially as neither Professor M'Coy, who had figured *Dithyrocaris* (see Plate XI. fig. 9 ‡), nor Dr. Scouler (the original describer of the genus), had attempted to connect them: he wished to find a specimen with the teeth attached.

At length, after diligent search, Mr. Bennie was so fortunate as to obtain, at Lickprivick Quarry, East Kilbride, Lanarkshire, a portion of a carapace (Pl. XI. fig. 6), upon the under side of which he discovered the long-looked-for teeth *in situ* (fig. 6, *a*, *b*). This discovery is the more acceptable, because the teeth have never yet been met with at Carluke, where the carapaces are found, although the Carboniferous beds have been diligently searched for fossils by Dr. Rankin for at least thirty years, whilst the localities already named as yielding the detached teeth do not furnish remains of the carapace.

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* See Annals and Mag. Nat. Hist., 3rd series, vol. v. p. 163.

† These specimens are in the British Museum.

‡ Copied from Prof. M'Coy's Carb. Foss. Ireland, pl. xxiii. fig. 2.

The teeth, with one or two exceptions, always occur in ironstone nodules, and the best specimens are those which have been 'weathered' out, as the fossil, being softer than the matrix, cannot readily be developed artificially. If exposed too long, being calcareous, they become soft, and soon crumble away.

It is probable that the soft parts of the animal (which contained the teeth), having been, after death, detached from the carapace whilst undergoing decomposition, became the nucleus for a concretion of phosphatic matter, which was added to, layer by layer, in the same manner as the concretions around organic remains in the London Clay, and the ironstone nodules containing leaves and *Limuli*, in the Coal-measures, appear to have been formed.

Mr. Armstrong informs us that the *Dithyrocaris* tooth from Campsie (Pl. XI. figs. 4 and 4 *a*) occurs in a bed of black shale, overlying the 'Hosie' Limestone of the Lanarkshire Carboniferous series, which is about 670 fathoms below the 'Ell Coal.' This is the horizon usually taken by the Glasgow geologists in giving the position of Carboniferous fossils. No other specimen is recorded from this locality.

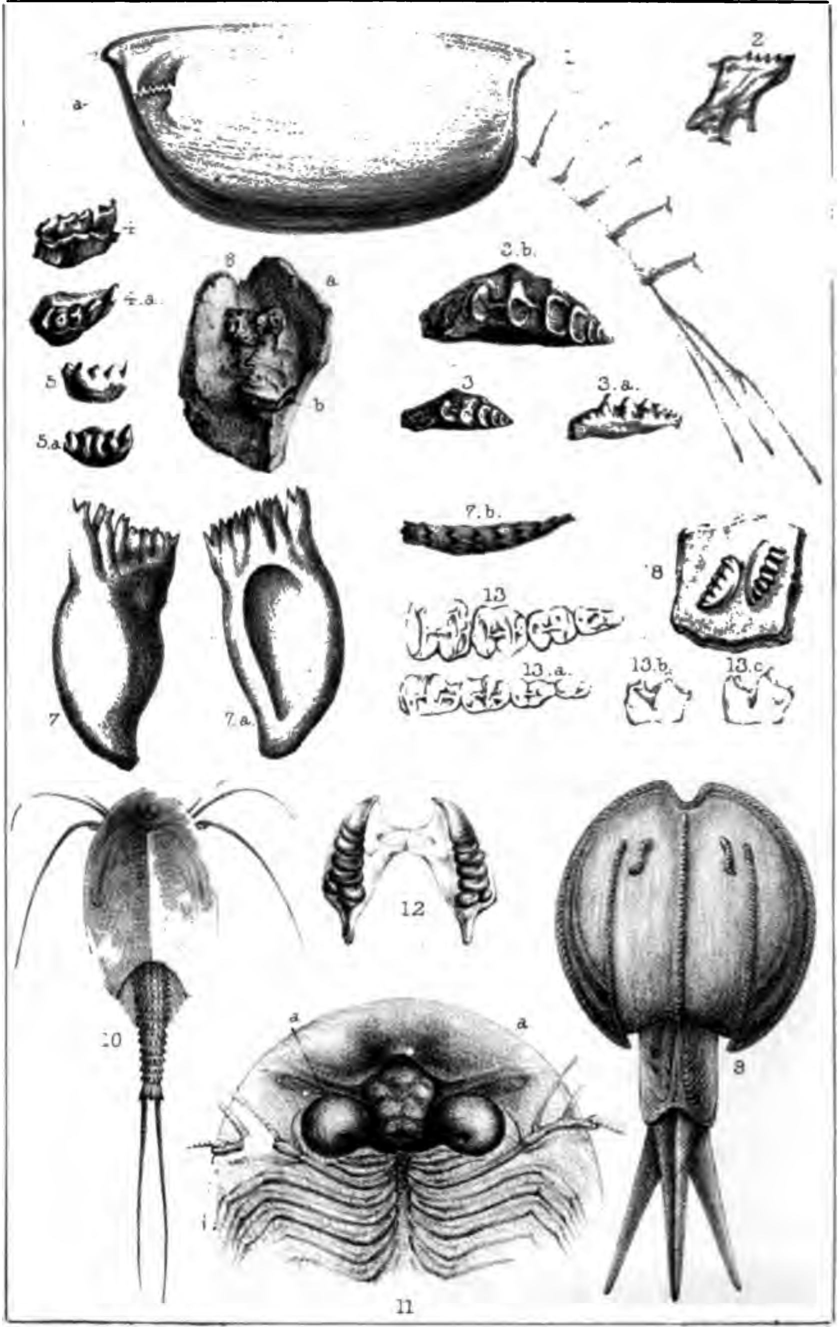
Its associated fossils are *Nucula gibbosa*, *N. lineata*; *Leda longirostris*, *L. attenuata*; *Nautilus subsulcatus*; *Goniatites Gilbertsoni*, *G. vesica*; a profusion of *Spirifera Urii*, *Orthoceras pygmæum*, and a large *Cythere*?

Those from Orchard Quarry, near Thornliebank, Renfrewshire (Pl. XI. figs. 3, 3 *a*, 3 *b*, and 5, 5 *a*), are from a bed of shale about 300 fathoms below the 'Ell Coal.' The common fossils in this bed are several species of *Cypricardia*, *Leda*, *Orthoceras*, *Productus costatus*, *Bellerophon Urii*, *B. Leveilleanus*, *Macrocheilus*, *Pleurotomaria monilifera*. No trace of carapace has been discovered at either of these localities.

The specimen with the teeth attached to the portion of carapace, from East Kilbride (Pl. XI. fig. 6), was found in shale associated with *Brachiopoda*, Corals, &c. The teeth are common at Orchard Quarry, but only a single specimen has been met with either at Lickprivick or Campsie.

That these detached fossil remains are the teeth of Crustacea there cannot now be the least doubt; for, in addition to the evidence afforded by the remains of the allied genus *Ceratiocaris* (Pl. XI. fig. 1), and by the fragment of *Dithyrocaris* (Pl. XI. fig. 6), one needs only to compare the gastric teeth of the common Lobster (*Homarus vulgaris*), figured in our plate (fig. 12), with the most perfect tooth of *Dithyrocaris* (figs. 3, 3 *b*), to see the striking similarity between them, both in general form and in minuter details.

They so strongly resemble the molar teeth of the Vertebrata also,



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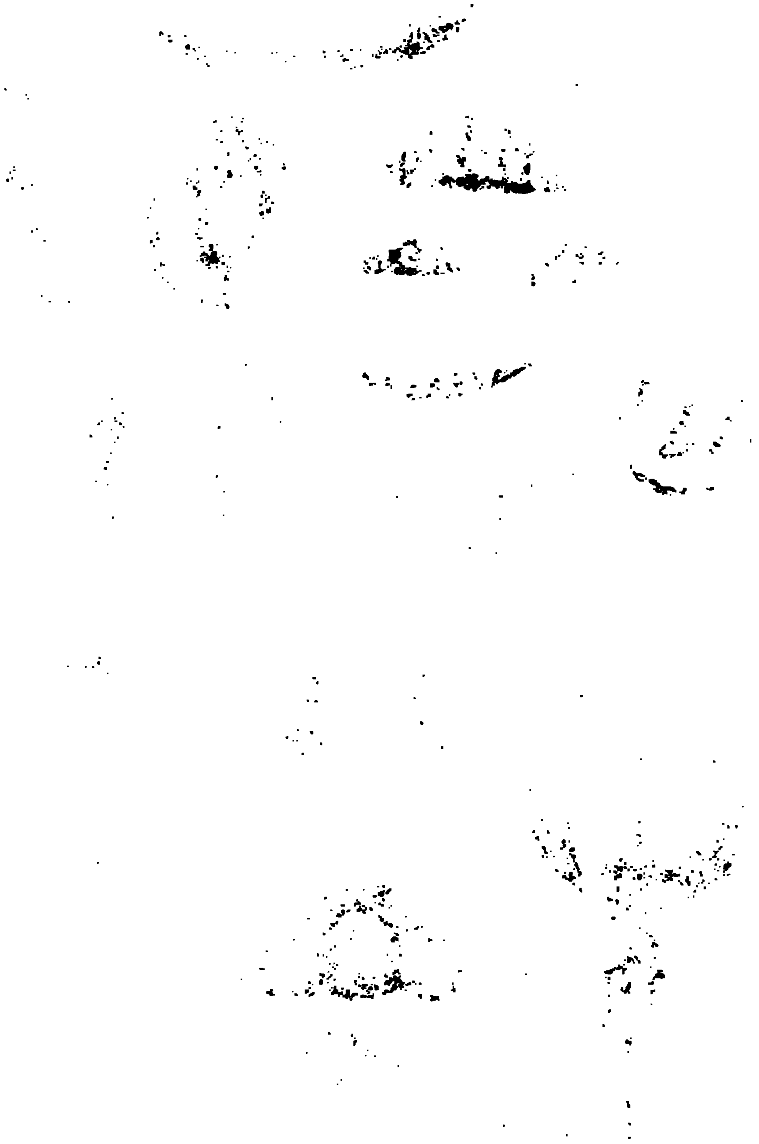
M & N. Hanhart, Imp.

TEETH OF CRUSTACEA, &c.



that Dr. Günther at first sight supposed them to be Fish-teeth allied to the *Sphæridæ* or *Labridæ*; whilst Prof. Owen and Mr. Waterhouse, to whom they were submitted for inspection, noticed their great superficial resemblance to the teeth of some small Marsupials, such as the Kangaroo Rat (*Hypsiprymnus*) of Australia.

The important bearing of these 'superficial' resemblances cannot be too strongly impressed upon Palæontologists, and especially on those who work in that Border-land between the Palæozoic and Secondary rocks—the Rhætic and Triassic groups. For it was in the Rhætic Bone-breccia of Würtemberg that Prof. Plieninger discovered the teeth of the then oldest known Mammal, the *Microlestes antiquus*; and in a fissure of the Carboniferous Limestone near Frome, Mr. Charles Moore, of Bath, found that wonderful accumulation of minute teeth and other organic remains from a Bone-bed of the same age; and Mr. Boyd Dawkins detected the tooth of the oldest British Mammal (the *Hypsiprymnopsis Rhæticus*) in the Lower Rhætic of Watchet. These teeth, all very minute, often very obscure, require the closest scrutiny, and wherever it is practicable their structure should be microscopically examined.

In the Mammalia the molar teeth are all provided with double roots or fangs; there is also a well-marked division or ridge which surrounds the base of that part of the tooth which is exposed above the gum—a character which distinguishes them from those of Fish and Reptiles. But if the crown only of the tooth of a small fossil Marsupial be compared with a part of one of these gastric teeth of *Dithyrocaris*, these characters will scarcely suffice to distinguish between them, and we must examine their more minute structure.

In the plate I have given figures (13 and 13 *a*, *b*, *c*) of the teeth of a young Kangaroo (*Macropus*) for comparison with the enlarged figure (fig. 3 *b*) of the tooth of *Dithyrocaris*, which will serve to show many superficial points of form which they possess in common.

Fig. 10 is the recent *Apus* (from near Prague in Bohemia), of the natural size, for comparison with *Dithyrocaris* and *Ceratiocaris* (figs. 1 and 9). Fig. 11 is an enlarged view of the same, showing the jaws (*a*, *a*) *in sitû*; whilst figs. 7, 7 *a*, and 7 *b*, represent these dissected out, and magnified about seven times. There is a considerable difference between the serrated mandible of *Ceratiocaris* and the more solid and massive teeth of *Dithyrocaris*; and among these, also, there are at least two distinct forms: but we need more materials before we can determine to which species these several forms of teeth belong.

EXPLANATION OF PLATE XI.

Fig. 1. *Ceratiocaris papilio*, Salter. U. Ludlow Rock, Lanark.
2. *C. papilio*, Salter. Detached jaw from same locality
3. Nearly perfect tooth of *Dithyrocaris*, Upper Marine series, Orchard Quarry, Thornliebank, Renfrewshire.
3 *a*. Side view of same.
3 *b*. Enlarged view of grinding surface of same, showing the fine striæ in the recesses of the C-shaped cusps.

4. Another tooth of *Dithyrocaris*, from the Lower Marine series, Campsie.
4 *a*. Upper view of same.
5 & 5 *a*. Side- and upper view of another specimen, from Orchard Quarry.
6. Fragment of the fore-part of a carapace of *Dithyrocaris*, showing the under-surface, with portions of the two 'molar' teeth (*a*, *b*) seen *in sitû*. From Lickprivick Quarry, East Kilbride.
7, 7 *a*, & 7 *b*. Magnified views of the outer and inner sides and the grinding surface of jaws of *Apus*. Recent from Bohemia.
8. Fac-simile of General Portlock's figure of teeth of *Dithyrocaris*, in the Geol. of Londonderry, pl. xii. fig. 6.
9. *Dithyrocaris Scouleri*, M'Coy, Carb. Foss. Ireland, pl. xxiii. fig. 2.
10. *Apus cancriformis*, sp. Recent from Bohemia (nat. size).
11. Ditto. Enlarged view of under-side to show jaws in place (*a a*).
12. Gastric teeth of common Lobster, *Homarus astacus*.
13. Upper molar teeth (right side) of a young Kangaroo, from Australia.
13 *a*. Lower ditto („) ditto.
13 *b* & *c*. Detached teeth of (*b*) upper and (*c*) lower jaw of same.

III. REMARKS ON THE GENUS POLYPORITES.

By E. W. BINNEY, F.R.S.

LINDLEY and Hutton, in their 'Fossil Flora' (vol. i. p. 181), give a plate and description of some specimens, termed by them *Polyporites Bowmanni*, which were found by the late Mr. J. E. Bowman, F.L.S., in the Carboniferous strata, near the entrance of the Vale of Llangollen, in the county of Denbigh.

In the notes on the first specimen no doubts are expressed as to the nature of the fossil; but with respect to the second specimen, the authors say, 'It is a matter of great doubt whether this really belongs to the vegetable kingdom. Mr. Bowman remarks that his second specimen might be taken for the scale of a Fish, or of some great Saurian Reptile; and we admit it now without daring to offer any decided opinion about it, chiefly on account of its resemblance, in some respects, to some cellular plants of the present era.'

Some twenty-five years ago, Mr. Bowman showed me both the specimens, and I immediately recognized them to be scales of the genus *Holoptychius*, since changed to *Rhizodus*; and that gentleman was of the same opinion, and stated to me that he always had doubts as to the vegetable nature of the fossils. Probably I should not have taken any notice of these mistaken fossils; but in looking over M. Adolphe Brongniart's excellent work, 'Tableau des Genres de Végétaux fossiles considérés sous le point de vue de leur classification botanique et de leur distribution géologique,' I noticed that, at page 6, in speaking of the 'Famille des Champignons, he says, 'MM. Lindley et Hutton, dans leur *Fossil Flora*, ont désigné sous le nom de *Polyporites Bowmanni* un fossile qu'ils comparent, quoiqu'avec doute, à un *Polyporus*, et qui provient des mines des houilles du pays de Galles. J'ai observé une empreinte analogue dans les échantillons du terrain houiller de Sardaigne, et qui ne paraît pas différer du *Carpolithes umbonatus* de Sternberg: quelques points de cette empreinte offraient des pores peu profonds semblables à ceux de certains des pays chauds.'

Professor Unger, in his 'Chloris protogæa—Beiträge zur Flora der Vorwelt,' at p. cviii. in his 'Index of Fossil Plants,' mentions the *Polyporites Bowmanni*, Lind. and Hutt.: and at page xxix., under Ord. VI., Fungi, refers to *Polyporites Bowmanni*, under which genus he places, with a query, *Carpolithes umbonatus* of Sternberg, and gives the locality of Messrs. Lindley and Hutton's specimen, 'In Schists lithant, ad Wrexham, Angliæ.'

The mistake having been copied into such works of high repute as those of M. Brongniart and Professor Unger, has induced me to make these few remarks. The plate in Messrs. Lindley and Hutton's work bears such clear evidence of the specimens being undoubted scales of *Rhizodus*, that there will be no need to figure them again, a reference to their plate being quite sufficient.

It is rather singular that so evident a mistake as this is, namely, of describing as belonging to the vegetable kingdom a fish-scale very commonly found in the Coal-measures, should have passed uncontradicted for so many years. The first discoverer of the specimens had great doubts as to the nature of the fossils; but these doubts appeared gradually to have grown less, and finally disappeared altogether, as other parties who knew less of the subject treated it.

NOTICES OF BRITISH AND FOREIGN MEMOIRS.

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I. Observations on 'Recherches sur les Squalodons,' par P. J. Van Beneden. 4to., 1865, pp. 85, Pl. I.–IV. Bruxelles.

By Prof. Owen, F.R.S.

In the 35th volume of the 'Memoirs of the Royal Academy of Belgium,' Prof. Van Beneden, under the above title, gives an account of most of the specimens of Zeuglodonts which have been discovered in Europe, commencing with the portion of jaw with teeth from the Miocene of Malta, figured by Scilla, in 'La Vana Speculazione disingannata del Senso,' 1670, tab. xii., fig. 1; on which Agassiz founded his genus '*Phocodon*,' in the 'Répertoire d'Anatomie et de Physiologie de Valentin,' 1835.—2. The next European Zeuglodont in point of date is the fragment of jaw and teeth from the 'grès marin' at Léognan, near Bordeaux, described, as part of a gigantic reptile, allied to the Iguanodon, and also to the Sharks, by Dr. Grateloup, under the name of *Squalodon* ('Actes de l'Académie des Sciences, Belles-lettres, et Arts de Bordeaux,' 2^{me} année, 1840).—3. An atlas-vertebra, from the Miocene 'Faluns' at Salles, noticed by J. Müller in his account of the American Zeuglodonts acquired by the Royal Museum at Berlin, in the 'Transactions of the Royal Academy' of that city, 1847, and 'Ueber die

Zeuglonden,' fol., 1849.—4. Teeth and vertebræ from Miocene beds at Eibergen and Swilbrock, in Guelderland, referred by me to the genus *Zeuglodon*, and subsequently described by Staring in his 'Bodem vom Nederland,' vol. ii., p. 216, pl. iii.—5. An almost entire skull from the Upper Miocene at Barie, Département de la Drôme, described by Professor Jourdan, in 'Comptes Rendus de l'Académie des Sciences,' November 1861, and referred to *Rhizoprion Bariensis*, Jdn. The fore-end of the upper jaw of this specimen is described and figured by Professor Gervais, in the 'Bulletin de l'Académie Royale de Belgique,' tom. xiii., No. 5, 1862. —6. Portion of cranium, a petrotympanic bone, a laniariform tooth, an atlas, and other vertebræ of a large Zeuglodont, discovered by Ehrlich (1842) in the Molasse in the vicinity of Lintz, referred by H. von Meyer, in 1849, to *Balænodon linteanus*. Van Beneden figures, in pl. iv. of his memoir, the portion of the cranium as belonging to a Zeuglodont genus, which he calls *Stenodon*.*—7. Almost complete skulls of adult and young Zeuglodonts, with laniariform and serrated molar teeth, also discovered by Ehrlich at Lintz, in Upper Austria, and noticed by Klipstein, in Karsten and Decken's 'Archiv,' 1842. Van Beneden gives a restored figure of the skull and dentition of this specimen in his pl. iii., and refers the species to *Squalodon Ehrlichii*, V. B. Two of the teeth, from Lintz, are figured by J. Müller, *op. cit.*, fol. xxiii., fig. 7.

The chief part of M. Van Beneden's work is devoted to the Zeuglodont fossils from the vicinity of Antwerp. The portions of skull enable him to describe the intermaxillaries which exclusively form the end of the rostrum, and are firmly and extensively united to each other: each intermaxillary bears three teeth, of which the foremost projects on the axis of the bone. Of the maxillary the author describes three portions; the hindmost showing the convexity of the palatal portion, and the junction of the vomer. The mandible is represented by various fragments, which indicate a long symphysis, extending as far back as to the two-rooted molars. The above-named portions of bone, and divers teeth, are all the parts on which the *Squalodon Antverpiensis*, V. B., is founded. In the figure, pl. i., of this species, the skull is restored in outline from the specimens previously discovered at Lintz and Barie.

The dentition is computed to consist of—

Incisors, $\frac{3}{3}$; canines, $\frac{1}{1}$; premolars, $\frac{4}{4}$; molars, $\frac{7}{7} = \frac{15}{15}$.

This formula gives only the teeth of one side of the upper and lower jaws.

The skull of the Zeuglodont from Lintz shows the massive character of the zygomatic arch, and the small size of the cranial cavity, which is widest behind. The vomer is canaliculate superiorly. The posterior walls of the nasal passages are wanting;

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* This name has been bespoken, in 1832, by Aredinet-Serville, in the 'Annales de la Société Entomologique de France,' for a genus of *Cerambycini*; also by Richards, in 1836, for a genus of *Salmonidæ*.—Appendix to Back's 'Narrative of Arctic Land Expeditions.'

the anterior walls indicate an oblique direction ; whilst in the skull from Barie the nasal passage is vertical : no trace of nasal bones remains.

M. Van Beneden states, 'Les os palatins sont disposés comme dans les véritables Cétacés souffleurs : ils forment l'entrée des fosses nasales' (p. 49). I have found the palatine bones, in true *Cetacea*, separated from the posterior or palatal nostrils by the pterygoids, which exclusively form that entry to the nasal passages.

In the fossil skull of the *Zeuglodont* discovered at Barie, the nasals are compact bones, 'en os compactes,' situated above the blowholes, 'refoulés au-dessus des évents' (p. 53). The intermaxillaries, which exclusively form the end of the snout, extend thence backward to the nasal bones. The maxillaries posteriorly cover the frontals and reach the vertex : the frontals are very thick above the orbits : the malar is extremely slender. The occiput is flattened behind, rises also to the vertex, and forms there a crest which trends the occipital region : it is narrow behind.

The petrotympanics resemble those of *Zeuglodon*. The atlas-vertebra in the European Zeuglodonts, as in the American, is separate from the other cervicals. Prof. Van Beneden remarks that the Balænopteræ, certain Delphins, *e.g.*, the Belugas and Narwhals, and the Sirenia (Manatees and Dugongs), are among the small number of *Cetacea* in which the atlas is not anchylosed to the other vertebræ (p. 46). But to this list may be added the large Cachalots. The atlas from the 'Faluns de Salle,' figured by Van Beneden in pl. iii., fig. 2, 'offre une grande analogie avec l'atlas de Zeuglodon que Joh. Müller a décrit et figuré dans son grand travail sur les Zeuglodontes d'Amérique' (p. 47).

M. Van Beneden assumes that the nasal bones in all the European Zeuglodonts correspond with the condition of these bones in the mutilated portions of skull described by Jourdan, and regards the longer, perhaps more perfectly preserved, 'nasal' bones of the American Zeuglodont as justifying a generic distinction. He even goes so far as to conjecture that the American Zeuglodonts, notwithstanding their bulk, which rivals that of the Whales, were carnivorous Cetacea haunting the shores, like the herbivorous Dugongs and Manatees, whilst the smaller European species were pelagic carnivora like the Grampuses and Porpoises. 'Les Zeuglodons, malgré leur taille, seraient donc des carnassiers littoraux, comme les Siréniens des herbivores littoraux, et les Squalodons seraient des carnassiers pélagiques' (p. 63). But the deposits in Alabama and Louisiana containing Zeuglodont remains are strictly marine. The external nostrils of these large Zeuglodonts open in the upper part of the skull, far behind the end of the snout : some difference in the direction of the nasal passages is admitted by Van Beneden to exist in the European Zeuglodonts, as, *e. g.*, between the *Squalodon Ehrlichii*, Van Beneden, and the *Stenodon lentianus*, V. B.

We doubt whether, from present materials, so trenchant a distinction can be relied on as generically differentiating the Zeuglodonts, and as driving the colossal American species to seek their prey along or upon the sea-shore. For a second generic distinction Prof. Van Beneden relies upon a difference in the number of the teeth. He admits, however, both American and European Zeuglodonts to be essentially carnivorous Cetaceans; and every experienced student of such, from John Hunter downwards, had observed the variability of the number of teeth in individuals of the same species. Supposing that the present known portions of jaws and an entire unbroken maxillary or mandible of a Zeuglodont had never yet been found to support our author's conclusion—that the European Zeuglodonts have five double-rooted, serrate-crowned molars on each side of both jaws, in addition to the number of those in the American Zeuglodont (p. 62),—the question then arises, whether this dental character should be regarded as of higher importance than it is held to be in equally natural genera, or groups of existing carnivorous Cetacea, in which the numerical differences in similarly shaped teeth are noted amongst the specific characters.

The teeth of both the European and American *Zeuglodonts* consist of anterior laniariform, single-rooted, and posterior lamelliform, serrated, and two-rooted: in both, the first six are incisors, by reason of their implantation in the intermaxillary bones. But M. Van Beneden affirms that the foremost incisor extends on the axis of the body in the European Zeuglodont, and curves downward in the American—a difference which we do not believe can be absolutely predicated from the portions of the skull of the great American species hitherto examined. But, if admitted, and shown to be not related to the age of the individual, it may be questionable whether different directions of growth of homologous teeth should support generic distinction; for, if so, how many genera might not so be characterized out of the Elephants of India alone!

Admitting, however, for the sake of convenience, that the differences, so far as they appear to be shown by the mutilated remains of the Zeuglodont Cetacea, may be expressed by generic as well as specific differential terms, we have then to submit that the name *Phocodon* ought, on the ground of priority, to be given to the smaller European kind.

Prof. Van Beneden admits that the name *Basilosaurus*, proposed in 1832 for the American kind, was 'malheureusement trop significatif,' and agrees with Harlan and myself in the change of name to *Zeuglodon*, which, since 1839, has been adopted; but, while characterizing the name Squalodon as being 'également trop significatif,' he adds, 'Nous ne voyons aucun motif plausible pour changer le premier nom qui lui a été imposé par Grateloup' (p. 4). The motive, more than plausible, for not adopting *Squalodon*, is, that it has neither priority as regards the Zeuglodonts generally, nor as relating to European Miocene Zeuglodonts in particular. With much greater reason we may use the words of M. Van Beneden —'We see no plausible motive for changing the first name which had been imposed' upon the European Zeuglodont by Agassiz.

True, indeed, that name also was too significative of the conclusion at which the celebrated Palæontologist of Neufchâtel had arrived, in 1835, respecting the Pliocene character of the portion of jaw and teeth from the Miocene 'grès marin' of Malta. But the name *Squalodon* was quite as significative of the conclusion at which the Palæontologist of Bordeaux had arrived, in 1840, as to the transitional character between Iguanodons and Sharks of the animal owning the portions of jaws with teeth from the 'grès marin' of Léognan.

If the error-suggesting character of the name, which is barbarous to boot, does not weigh with M. Van Beneden against the fact of its having first designated the fossils from Léognan described in 1840, with what claim to consistency can he reject the classical name *Phocodon*, which first generically designated the fossils from the Miocene of Malta, described in 1835, and figured as far back as 1670?

Prof. Von Beneden appears to us to mete out one measure to one individual, and another to another, and not to be governed by principles which have no respect to persons.

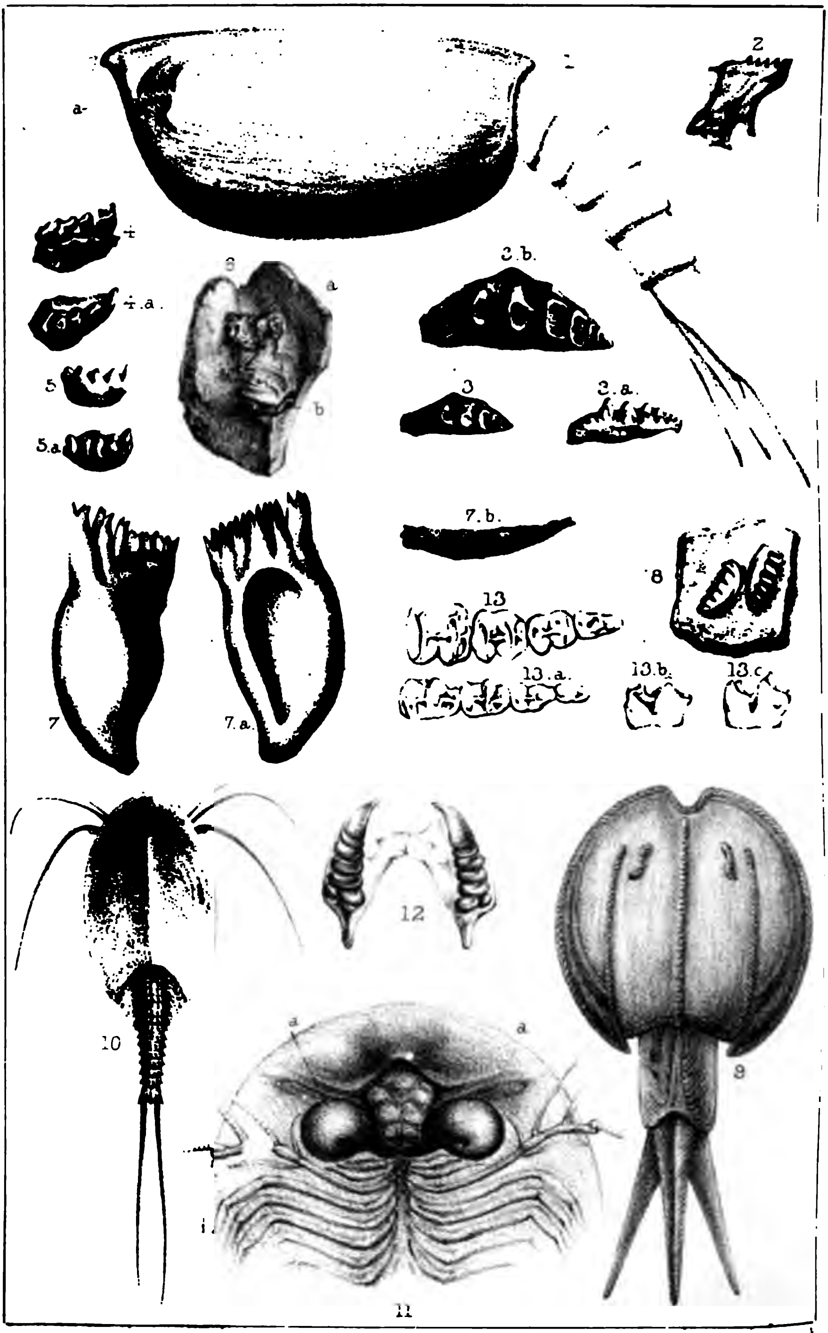
We may sympathize with goodnatured and indulgent sentiments that sway, for the conservation, on the sole ground of priority, of a generic name, although it may express obtrusively an erroneous or absurd conclusion, and be of barbarous construction besides. But then we require that the same sole principle of priority should be, at least, equally operative in regard to a legitimately constructed generic name, and one which does not shock the judgment by suggesting affinities very remote from truth. In this predicament we hold to be the *Phocodon* of Agassiz and the *Balænodon* of Owen.

The latter generic name was proposed for the physeteroid Cetacean to which, in the year 1840, I referred the larger petrified laniariform teeth from the 'Suffolk Crag.' In my account of form, structure, and microscopical characters of these teeth, in the 'History of British Fossil Mammalia,' I compared them with the teeth of the Cachalots, and also, from the proportion of the number of teeth with the number of Cetacea represented by fossil bones, and especially ear-bones, with the *Ziphius* of Cuvier. These proportions, I wrote, 'would indicate that the teeth were less numerous in the extinct Cetaceans, from which they have been derived, than they are in the Cachalot. The recent *Ziphius* has but a single tooth on each side of the lower jaw when full grown, like the great *Delphinus tridens* of our own seas' (*Op. cit.*, p. 541).

The petrotympanic bones or 'Cetotolites' described and figured in the same work are referred to another genus. *Balænodon physaloïdes* is described in a section distinct from the family *Balænidæ* (p. 542).

Balænodon, or *Phalainodon*, signifies a genus of Cachalot-like or Ziphioïd Cetacea, represented by the fossil teeth resembling those figured at p. 525, fig. 219, in contrasted contiguity with the Cachalot's tooth, fig. 218; at p. 536, fig. 226, and at p. 537, fig. 227.

Subsequent discoveries have proved that these Cetacean teeth, or the majority of them, belong to a genus or genera more nearly related to *Ziphius* than to *Physeter*, and to be 'Ziphioïd,'—if, indeed, Geol. Mag. 1865. Pl. X.



M. Williams, F.L.S. del. et Sc.

M & N. Hanhart, Impt

TEETH OF CRUSTACEA, &c.

Fam. ZEUGLODONTES.
Genus SQUALADON, Grateloup.
Species 1. *Squalodon Grateloupii*, V. M.
„ 2. *Squalodon Antverpiensis*, V. B.
„ 3. *Squalodon Gervasii*, V. B.
„ 4. *Squalodon Ehrlichii*, V. B.
Genus STENODON, Van Beneden.
Species *Stenodon lentianus*, V. B.
Genus ZEUGLODON, Owen.
Species *Zeuglodon macrospondylus*, Ow.
„ *Zeuglodon brachyspondylus*, Ow.

II. ON A NEW FAMILY OF LABROID FISHES.

MONOGRAFIA DEI *PHARYNGODOPILIDÆ*, NUOVA FAMIGLIA DI PESCI LABROIDI, del Cav. Prof. IGINO COCCHI. Firenze (Florence), 1864, 4to., pp. 88.

SINCE the completion of Prof. Louis Agassiz' great work on Fossil Fishes, now nearly a quarter of a century ago, no work on general Fossil Ichthyology has been produced. The authors who have written upon the subject are both numerous and able, but its literature is only to be found scattered in various scientific periodical publications, journals, and transactions of learned societies, or in works specially devoted to the description of the fossil remains of some particular formation, locality or country, or of some genus or family. To the latter class may be referred the elaborate Monograph recently published by Prof. Cocchi upon an interesting though small group of Fossil Fishes only known as yet by their dental remains. Upon these few but very characteristic portions, and after careful examination of many specimens preserved in public and private collections in England, France, Germany, and Italy, the author founds his new family of *Pharyngodopilidæ* (so called on account of the peculiar laminated structure of the dental plates). This group he divides into three genera: *Phyllodus*, Ag.; *Egertonia*, Cocchi; *Pharyngodopilus*, Cocchi; based upon the number of the upper dentigerous plates, and the form and arrangement of the single teeth.

The genus *Phyllodus* was first named by Agassiz in 1843, and described in the 'Rech. Poiss. Foss.,' vol. ii. pt. 2, p. 238, and also in the same year by Prof. Owen, in his 'Odontography,' p. 138. It is distinguished by having but one upper and one lower dental plate, formed of a series of thin laminæ, each of which is composed of enamel, dentine, and bone. These laminæ do not simply form a series of broad flat plates, but they are also divided by vertical depressions into several series of denticles, which are convex on one surface and concave on the other, and the median row of which is always the largest. According to the number, size, and form of these, and of their accessory or lateral denticles, the author describes six new species, in addition to the six previously described by Agassiz.

The new genus *Egertonia*, Cocchi, of which there is but one species, is founded upon two specimens which the author found in the collections of Sir Philip Egerton and Dr. Bowerbank (and an imperfect fragment in the National Collection).' It has only one upper and one lower dentigerous plate, the denticles of which are much smaller and more equal in size and form than those of *Phyllodus.* They are of a round-pointed form, so that a slightly inclined vertical section would give the form of a truncated cone. The whole tooth, judging from the specimens known, is much smaller than that of *Phyllodus.*

With the exception of a Cretaceous species from Bilin, described by Prof. Reuss, all the species of the preceding two genera are exclusively British fossils of the Eocene period, and chiefly from the London Clay of the Isle of Sheppey. They are also found in the Red Crag, into which they have been drifted from the older Eocene deposit. The Continental specimens described as *Phyllodus* our author refers to *Pharyngodopilus* and other genera.

Pharyngodopilus, Cocchi, is characterized by having two upper and one lower dentigerous plate, the form and arrangement of the denticles of which are very different from those of *Phyllodus* and *Egertonia* ; though varying in form and size, they have not that extreme irregularity characteristic of *Phyllodus,* and are globular or elongated. The species are of Miocene and Pliocene age, and are unknown in British deposits, although two (*Ph. Africanus* and *Ph. Canariensis*) are founded upon specimens in the British Museum.

The genus was determined by the author in 1853, and then named by him *Labradus.*

To these three genera the author, in an appendix, adds a fourth (*Taurinichthys,* Cocchi), founded on part of a lower jaw bone with the dentigerous plate attached, and which had been previously described by Michelotti as *Scarus Miocenicus.*

In this notice we can do little more than direct attention to the work itself, which is a most valuable addition to the subject of which it treats. An attempt even to epitomize the author's descriptions of the mode of growth of the teeth, and the various species, with his reasons for forming them into a new family (detaching *Phyllodus* from the Ganoid group of Pycnodonts, where Prof. Agassiz had placed it, and arranging it with the Cycloids, to which order Prof. Owen, in his 'Odontography,' thought it belonged, though believing its affinities to be with *Scarus* among the *Labridæ*)—would occupy more space than we can afford.

The work is illustrated by six carefully executed plates containing several figures of all the species. We annex a list of those now added to our already rich catalogue of Fossil Fishes:—

Phyllodus Colei, Cocchi.
—— *hexagonalis,* „
—— *speciosus,* „
—— *Bowerbankii,* „

Phyllodus secundarius, Cocchi.
—— *submedius,* „
Egertonia isodonta, „

W. D.

III. The 'Natural History Review.' No. XIX., July 1865.

THIS Number contains two important Palæontological papers. One, 'On the Dentition of *Rhinoceros megarhinus,*' by Mr. Boyd Dawkins, is a very valuable communication: the author gives the geographical and geological range of the Tichorhine, Leptorhine, and Megarhine species of Rhinoceros, with a sketch of their literature, clearing up several doubtful points relating to the nomenclature of *R. leptorhinus*; he then describes the enamel structure of their teeth, the milk- and permanent dentition of *R. megarhinus*, giving a table of measurements of the teeth, and concludes with a comparison between the Megarhine and the several recent species of Rhinoceros. This memoir is illustrated by fifteen woodcuts.

The other paper is 'On Portions of a Cranium and a Jaw in the slab containing the fossil remains of the Archæopteryx,' by Mr. John Evans. Prof. Owen, in his paper on the Archæopteryx read before the Royal Society in 1862, stated that besides other less important portions of the skeleton, the head of the bird was wanting on the stone. Soon afterwards, Mr. Evans, having minutely examined the slab, discovered what he attributed to be parts of the cranium and jaw of the bird, and communicated this suggestion to Prof. Owen, who concurred with it, and, when his paper was published, had the portions referred to engraved on the plate containing the Archæopteryx, and called attention to Mr. Evans's discovery in the description of it. Mr. Evans discusses the question as to whether the jaw belongs to the Archæopteryx or to a fish, but is most inclined (and M. von Meyer is of the same opinion) to believe that it is part of the former, as he argues that there is no reason why the bird which presents so many anomalies should not also have been endowed with teeth, especially as there are no other bones in the slab to which the jaw might belong, and when fossils are discovered in the Solenhofen Limestone they generally occur singly, so that the remains of a vertebrate animal found upon a slab may usually, with some degree of confidence, be assigned to the same individual.

REVIEWS.

I. GRAPTOLITES OF THE QUEBEC GROUP. By JAMES HALL. Decade 2, Geological Survey of Canada. Montreal: DAWSON. 1865.

THE remarkable series of Graptolites discovered by the Geological Surveyors of Canada have been known to naturalists only from the descriptions published in one of the Annual Reports of the Canadian Survey by Prof. James Hall. These were sufficient to excite the curiosity of all interested in this long extinct family. It was evident that important materials would be supplied by the perfect specimens towards forming a true estimate of the systematic position of the family. But the descriptions referred to structures so different from anything known in Europe, that without specimens or good drawings it was difficult to estimate what would be their real value. In the volume before us, which forms the second decade of the 'Canadian Organic Remains,' (it, however, contains twenty-three plates,) we have the first means of satisfactorily understanding the discoveries. Prof. Hall here describes fifty-three species, and proposes six genera, which are either new, or known only from the descriptions in the Report to which we have alluded.

Graptolithus Logani may be taken as the type of the great novelty in the volume — the discovery of a corneous disk supporting the slender hydrosoma of the Graptolite at its origin. The hydrosoma of *G. Logani* consists of from eighteen to twenty-three simple branches, originating in a symmetrical series on either side of the simple primary base. The central disk, which in this species is about the size of a florin, envelopes the bases of the branches, and these do not bear hydrothecæ until they pass the margin of the disk. Prof. Hall considers that the disk is composed of two laminæ, which at least in the central portions are not conjoined, and the space was probably occupied by some portion of the animal body. He further considers that this structure is obviously adapted to give strength and support to the bases of the branches of the hydrosoma, and that it perhaps served other purposes in the animal economy. He does not refer to any analogous structure among recent animals, nor do we know anything among the Hydrozoa at all corresponding to it; but it agrees better with Cœlenterate structure than with Polyzoan, and so confirms the opinion now generally entertained that the Hydrozoa are the modern allies of the Graptolites.

The structure exhibited in *G. Logani* is considered by Prof. Hall as the perfect condition of the fragments of the monoprionidian species which have been hitherto discovered in Europe as well as in America. We cannot concur in this view. All the American species may be fragments of such compound individuals, but there are species found in Europe which could not be united into such a compound body. *G. colonus* of Barrande, as figured in his 'Graptolites de Bohême' (pl. ii. fig. 5), represents a zoophyte in which the older portion is free, and the growing end has the cœnosarc prolonged, and without hydrothecæ developed upon it. We are satisfied that this is a faithful representation of the species, as we have observed a similar structure in *G. sagittarius*, *G. Sedgwickii*, and an undescribed species—all of them from the Silurians of the South of Scotland. The older or proximal extremity of these species is always slightly recurved, and the hydrothecæ on this part are smaller than on the newer portion. If they are fragments of a compound organism, it must have been very different from that of *G. Logani*. A similar difficulty would prevent such forms as *Didymograpsus Forchhammeri*, figured by Baily in his paper on Irish Graptolites, being united into compound organisms. And there is yet another form of the monoprionidian type which it would be as impossible to combine: we refer to *Cladograpsus linearis* of Carruthers, figured in his paper on the Graptolites of Dumfriesshire. While, therefore, the Canadian Surveyors have added a singular and novel type to those hitherto known, there is no satisfactory ground for considering that the fragments of the Old-World monoprionidian species belong to such a compound form. We prefer, with Mr. Salter, to consider the group represented by *G. Logani* as forming a new genus, to which he has given the name of *Dichograpsus*.

Prof. Hall, it seems to us, has made a retrograde step in uniting under one generic name so many varied forms as make up his genus *Graptolithus*. The grounds upon which naturalists have separated *Plumularia* from *Sertularia* are held by him of no value in this fossil family. And not only is *Diplograpsus* united to *Graptolithus*, but the two distinct forms of *Didymograpsus* and *Cladograpsus* share the same fate. We are surprised that with this tendency to 'lumping' he retains *Rastrites*, a genus whose only character is that the hydrothecæ are distant from each other—a character that is rightly considered unimportant in *Sertularia*.

The new genus *Climacograptus* he has established for species like *Diplograpsus rectangularis*, which have the polype-cells hollowed out of the cœnosarc without being furnished with hydrothecæ. This character seems to indicate affinities to the *Corynidæ*.

It is probable that the genera *Thamnograptus* and *Bathrograptus*, on which no cell-openings have been observed, may be portions of compound Graptolites corresponding to either the cœnosarc or the hydrorhizæ of Sertularia.

Much yet requires to be done before we come to anything like certain knowledge of this interesting Palæozoic family. This volume is an important step to so desirable an end. With the light thrown by it on the structure of the family, it would be desirable to have a re-examination of our British species. They are not at present in a satisfactory condition. Everyone who has come across them has added somewhat to our knowledge of the species; and so one must consult the papers of Murchison, M'Coy, Salter, Harkness, Nicol, Carruthers, Baily, &c., to get acquainted with what has been done; for nothing like a monograph has yet been executed. Prof. Wyville Thompson is engaged, we believe, with one for the Palæontographical Society. If he succeeds in obtaining tolerably complete specimens of the species he describes, and does not satisfy himself with founding his characters on and figuring fragments of the hydrosoma, as has been too much hitherto done, we shall be better able to form a satisfactory estimate of the relations of the family.

II. Frost and Fire, Natural Engines, Tool-marks, and Chips, with Sketches taken at Home and Abroad by a Traveller (J. F. Campbell). Edinburgh: Edmonston and Douglas. 1865. 2 vols. 8vo., pp. 1015. 117 Illustrations.

III. A Short American Tramp in the Fall of 1864. By the Editor of 'Life in Normandy.' Edinburgh: Edmonston and Douglas. 1865. 8vo., pp. 427.

THESE two works are by the same writer, and they both treat of what we may call the *mechanical* phenomena of Geological Science. The first was published latest; but as it contains a statement of the author's theories, and relates the story of his earlier travels in pursuit of his favourite study, we have given it precedence. They are written in a lively (at times, indeed, in a rather too lively) and readable style; and 'Frost and Fire' is illustrated with woodcuts of every description, scientific, topographical, and humorous, with maps; one of which, and one of the woodcuts, are also to be found in the second work. This 'American Tramp' may also be recommended as an amusing account of a hasty tour in the Southern States of the Union, and exhibits some otherwhere unrecorded scenes of that country during the fourth year of their great Civil War. There are too many extracts from journals of travel, in Iceland, Norway, the Alps, &c. &c., in 'Frost and Fire.' The facts which Mr. Campbell has accumulated and illustrated cannot fail to be of the greatest value to geologists, as they so widely extend the substantial basis on which all geological theory must be founded, and afford the means of confirming or correcting hypotheses regarding the most universally interesting phenomena, which relate, to those who understand them rightly, the history of the way in which the surface of our earth was brought into its existing configuration. They who have leisure and means at command may also be induced by these works to engage, as the author has done, as a 'volunteer' in the cause of what Sir John Herschel has called the grandest of all sciences except Astronomy, and make their periodical tours more exciting and more fruitful than the mere going where others have been, and seeing what others have seen, and 'doing' what others have 'done,' can ever prove. Perhaps, with this view, we might regret that instead of the two large volumes of 'Frost and Fire,' we had not before us a single volume with less of hypothesis, a clearer arrangement, and a more condensed statement of the facts treated of, which might have become a *Manual* of this branch of scientific enquiry, and a work of permanent interest. But it requires experience in authorship, or a certain natural talent, to produce a book of this kind; and as it cannot be doubted that Mr. Campbell has done what he has accomplished well, and has gained the ear of the scientific world, we venture to hope that his next literary enterprise will be of the sort we have described. Our space does not allow us to discuss the hypothetical portion of 'Frost and Fire,' nor is it, where it is novel, of so much value, as the earnest inculcation of the habit of accurate observation of facts, and of reasoning from the known to the unknown, in the investigation of causes, by which the book is characterized. But we must allow Mr. Campbell to tell us what his object has been; and if he has (as we think) succeeded in attaining a far more generally serviceable one, and instead of establishing a hypothesis, has produced a book such as we have described above, he has no great cause to lament his failure. The Preface to 'Frost and Fire' thus opens:—

'The title-page of the first volume is a key to the contents. The book treats of forms, and it is illustrated from sketches made abroad and at home by the traveller who wrote the book. It treats of forms and of engines, and of forces which drive engines; of sculpture and of chips which are tool-marks of natural engines. On the title-page, the word "Frost" is written over snow, and above the top of

Hecla; the word "Fire," under steam in "Strokr," and under the sea. The book attempts to prove that both of these natural forms, which were copied from nature in Iceland—the cold conical snow-clad pile built about a hot crater, raised high in cold air; and the conical pit, from which steam casts boiling water along rays—are tool-marks of natural engines, which shape the earth's crust, and are moved by frost and fire: by cold above, and by heat underground. The atmosphere and the ocean above-ground, solids, fluids, and gases under it, are the engines meant; sedimentary and igneous rocks are the chips and cinder-heaps; mountain-forms the tool-marks of these engines, and the ultimate cause of their movements must be the will of Him who made them all.

'Every engine of man's contrivance is moved by some power; each engine-fire is but a link in a chain which leads back to the first inventor of steam-engines. It is argued that every natural engine must also have some motive power, beyond which is the Will of Him who said "Let there be light."

'The aim of this book is to show that where light shines, there also force radiates; and there forms result from movements caused by ray-force, or by light.'

We cannot close this notice without speaking of the excellent printing and 'getting-up' of these interesting volumes.

"SCRIPTURE" GEOLOGY.

IV. THE SACRED STEPS OF CREATION; OR, THE REVEALED GENETIC THEOLOGY ILLUSTRATED BY GEOLOGY AND ASTRONOMY. In Twelve Lectures. By the Rev. THOMAS MARSDEN, B.A., &c. &c. 8vo., pp. 408. London: LONGMANS. 1865.

THE work before us is one of those productions which have appeared periodically since the great advancement of Geological Science during the present century, and which have as their most usual object, the reconciliation of the facts of scientific research with the author's own notions and interpretations of the sacred records. Some law, akin to that which sends the earth at stated intervals through zones of shooting stars which surround its path for a few weeks, and then quietly explode, ofttimes with a sulphureous odour, seems always to destine Geology to be impeded with this class of equivocal literature, of which the essential point appears to be embodied in the doctrine, that those scientific men who do not accept the author's conclusions are too demoralized to require deliberate refutation.

The Rev. Mr. Marsden, however, is by no means intolerant. As he can justly be cited as the first author who has triumphantly succeeded in the supererogatory task of spelling the word Eozoon with *four o's*, we would not willingly attach to him the stigma of illiberality. And whilst the use of such expressions as 'Brogniart,' 'anychylosed,' 'Caucassian,' 'Deluvium,' 'Quatrefayes,' 'Brainular,' 'psy-chi-cally,' 'Jrenian,' 'Hametic,' and many other similar blunders, might be supposed to detract from the value of a scientific work, we should not in this sense criticise unfavourably any author who showed signs of deeper acquaintance with the problems of science than his printer.

Plunging, on his ninth page, into the assertion of a law 'that we can conceive no essential difference . . . between a brick and an archangel,' he proceeds to correlate the Geological and Mosaic accounts of Creation *ab initio.* Wisely eliminating the Miltonian accounts of the Fall of Angels and Man from scientific consideration, he thus translates Genesis i. 2:—

'And the earth was without stratification (Tho-hû) and without cleavage—i.e. crystallized (Vo-hû),' &c. &c.

After the above, our readers can well imagine that Hebrew may mean anything, especially if interpreted on the philological maxim, that 'consonants are interchangeable, and that vowels don't count.' According to Mr. Marsden, the solar system existed first; the world was then introduced from without into it (p. 27). We learn this (he states) from the Word of God, and we are bound to accept it reverently. After this, we must not be surprised when our author, in the next line, states that he is a 'convulsionist.' *We think so.* It is furthermore, according to this interpreter, 'certainly revealed' that the earth was granitic when the six days' creation began. We are glad to hear this: the announcement of the fact will probably save some of our mineralogists much labour, which they may spare, if they submissively sit at the feet of our scientific Gamaliel.

We are pleased to see a palæontological proof adduced by him that the earth did not at first revolve (page 100). 'It is also remarkable that vertebrate fishes commenced with rotation, and the heterocercal tail ceased when the earth began to revolve in an orbit.' The author's prevision here must have induced him to pen these remarks a few millions of years in advance; for, as we must tell him that the heterocercal tail in fishes has not yet ceased (the sturgeon and shark being familiar examples), we must accept as a logical corollary from the above sentence, that the earth does not even yet revolve!

If Palæozoology in the hands of Mr. Marsden becomes unsafe, Palæophytology under his auspices comes to irremediable grief. Thus he says, as a corroborative of the exactitude of the statement contained in Genesis i. 11, 'I know of no terms which could more briefly or accurately describe to us the stemmy Equisetaceæ—the ferns with seed on their leaves—the *Stigmaria*—or, again, the firmly-rooted *Sigillaria*, some of them with kidney-formed seed, arranged upon the outer bark;' and on the next page, 'In these knobs and kidneys we have, doubtless the seed,' &c. Apparently our author is not aware of the fact, that the markings in which he takes such complacent delight are leaf-scars. Similar scars can be seen on the sides of every bamboo-cane, which nevertheless may bear a very indirect relation to the Fourth Day of Creation.

As a strong teleologist of course he says, 'Nature plainly speaks of adaptation. The atmosphere is made for the wing of the bird, and wings are adaptations for the aërial voyager. . . The ostrich is for the sand, and the sand for the ostrich. The duck's bill for the mud, and the mud for the duck's bill.' As geologists, we must put in a plea for the manner in which the inorganic substances are treated in this quotation. We almost fancy it is possible that the atmosphere, the sand, and the mud may have other objects than the convenience of the bird, the ostrich, and the duck. However, the use of mud in a geological sense is not a point wherein we are qualified to argue with Mr. Marsden.

He is fond of quoting inaccurate authorities, one of whom (p. 193) says, speaking of tree-ferns, 'In tropical countries . . . there are many more species than in temperate climes, and some of these are arborescent, or of a tree-like size and luxuriance.' New Zealand, which is certainly not within the tropics, is, however, essentially the land of tree-ferns; which fact is slightly irreconcileable with our author's assumption.

In spite of the orthodoxy of Mr. Marsden, he has a most unfortunate habit of quoting the 'Vestiges of Creation.' It is certainly heretical enough to admit the points on which the writer of that remarkable work founded a somewhat correct argument; but to quote the 'Vestiges' when *wrong* is the very extravagance of charity. Our author says on the authority of that work, that the Pterodactyle was 'a lizard about the size of a snipe.' The large species of Pterodactyles described by Prof. Owen and Mr. Harry Seeley would seem, therefore, not to exist. Although Mr. Marsden is good enough to say, 'It has pleased God, however, to overrule and to utilize the mind and labours of Prof. Owen to confirm the truth of this portion of His revealed word,' he has been sufficiently cautious to reserve the right of appeal to himself in controverted points.

The fact that the planet Mercury was received into our solar system at the time of the creation of man is one on which our author appears to entertain no doubt. However, says Mr. Marsden, animal-men, having some resemblance to the lower animals, existed for ages before the present creation of spiritual man. As the accomplished author of *Λιθωφονήμα* remarks—

'My infant intellect began
T' act when the archetypes of man,
Dawn of a still-advancing day,
Apes, sported o'er the marl and clay.'

He quotes Prof. Schaaffhausen to the effect 'that the proportions of the Neanderthal skeleton do not differ from the ordinary standard;' which, considering how much longer one arm of the skeleton was than the other, is charging Prof. Schaaffhausen with a good deal.

We have only space for the notice of one further point in this work. The difficulty regarding Jonah and the whale is most satisfactorily disposed of. The fish was not living. It was 'the ruins or floating carcase of a fish sufficiently denuded on its upper surface to swallow up the prophet into its cavity or belly, on his being thrown overboard.' After Jonah had been in this unpleasantly odoriferous locality for three days, the fish 'vomited or ejected

Jonah upon the dry land. The apparently living acts ascribed to the fish are spoken of inanimate objects.' How it can be said that a dead fish with its dorsal surface denuded could vomit, we cannot understand; and our readers must enjoy a greater power of deglutition than the whale itself if they can unravel this incomprehensibility.

In the above remarks, it has been our object to select such average passages as should give a notion of the scientific qualifications of the present writer to reconcile the two records of Scripture and Science. It is not for us here to offer any opinion whether or not such a reconciliation may be ultimately probable. But the present occasion is so unsuitable to discuss this grave question, that we must close this notice with the expression of our opinion that no one ought to attempt so hazardous an undertaking who is not thoroughly conversant with the facts and deductions of modern geology; and the author's quotation of the prayer of the penitent thief upon the cross, as his farewell word, appears to intimate his conviction that he had attempted and failed in a task beyond his power.

REPORTS AND PROCEEDINGS.

EDINBURGH GEOLOGICAL SOCIETY.—On June 19th, the concluding Meeting for the session was held; Mr. David Page, F.G.S., F.R.S.E., Vice-president, in the chair. Mr. A. Beattie was elected a Member.

Mr. NEIL STEWART read a paper *On Fossil Trees in Sandstone Beds; and the Manner of their Deposition and Preservation as Evidences of Quicksands in Geological Periods.* He first described the main character of what are termed 'snags' in the Mississippi as illustrative of his subject; and then he gave a description of the fossil trees that have been found in Craigleith Quarry, near Edinburgh, and elsewhere. He showed that a general distribution of drifted plants had taken place over the whole area of the Carboniferous rocks, on different planes, and that some of those plants had come within the influence of petrifying fluids, which had preserved their structures, and that those fluids had permeated their structures by *endosmose* and *exosmose.* He stated that fossil trees had been deposited in a manner similar to that in which trees are in the course of being daily embedded in the sands of rivers, bays, &c., at the present time. He also stated that the microscope clearly shows that plants when found in an erect position, or nearly so, have not had their tissues flattened by compression. Mr. Stewart then described fossilization by means of petrifaction, and gave it as his opinion that the calciferous sandstones of the Carboniferous period formed the quicksands of the ancient seas.

Mr. PAGE then delivered the concluding address to the Society as follows:—In closing the session on behalf of our venerable President, who pleads the infirmities of age for the non-fulfilment of this duty, allow me to congratulate you on the amount of substantial work that has been accomplished since our meeting in November. During no former session have so many papers been read, or so large an amount of instructive discussion elicited. Nor have these papers, as sometimes complained of, been mere *résumés* or re-echoes of other people's opinions, but in reality the results of much local research and minute personal observation. We have had subjects ranging from the most ancient to the most recent geological periods—papers on the Silurians of Dumfriesshire and the Pentlands, the Carboniferous formations of Lanark and the Lothians, the Chalk-beds of England and the calcareous ooze of existing seas, the local drifts and denudations of the Glacial Period, the erratics of Northern Germany, and the upraised beaches of the Firth of Forth. Upon subjects so vast and varied, there was necessarily some diversity of opinion; but in no instance has difference of opinion been expressed in any other spirit than to elicit the truth and establish a satisfactory conclusion. One great merit, indeed, of most of the papers we have heard this winter has been what I may term their thorough individuality,—each author expressing his own opinion without stint, and submitting it to the equally candid criticism of his fellows. And this, I am sure you will agree with me, is no mean merit. As in nature there is no progress without action and reaction, and no action without a difference, so in moral and intellectual matters there can be no progress without those activities which arise from the differences of fully and freely expressed individualism. Each of us has his own modes of observation and his own modes of thought, just as he has his own style of face or peculiarity of body; and where this individualism is allowed to manifest itself, depend upon it there will be differences of opinion, and the result will be activity and progress. On the other hand, where individualism subordinates itself to authority and conventionality, action ceases and progress comes to an end. Let us continue, then, to cultivate this original gift of individualism, expressing the truth as it appears to us, yet ever remembering that for want of perfect knowledge we are liable to error, and that charity is ever due to those who see not as we see, or believe not as we may believe. And now that the winter-session is over, and the summer-excursions are at hand, I trust that the same spirit will be manifested in all our field-procedure. It may be objected by some that the excursions set down on the card are too numerous, and most of them over ground already well explored and familiar. In a Society such as ours, where many of the members are daily engaged in business, the number of excursions increases the chance of being present at some; and there is really in Geology no field so familiar but new facts may be gleaned, or old errors of observation or of inference may be corrected. Besides, the man who knows his own immediate district thoroughly has the best preliminary training for the comprehension of the geology of other lands. The denudations and superficial outlines in the neighbourhood of Edinburgh are the types of similar phænomena in other districts; the upheavals, outbursts, and interstratifications of Arthur's Seat, the

Calton Hill, and Castle-rock, are the exact counterparts of volcanic activity wherever it may be manifested; and the alternations of strata, the dykes and faults of the Mid-Lothian Coal-field, are but an epitome of similar appearances in every other Carboniferous area. Let no opportunity, then, be lost in noting what turns up in the digging of foundations and city-drains, in the sinking of wells and boring for water, in railway-cuttings and tunnels, in the numerous quarries in the vicinity, along the rocky shores of the Forth, and in the channel of every brook that brattles from the Lammermoors and Pentlands. Every well-observed appearance is a record for ever; every new fact adds another paragraph to that World-history which it is the great object of our Society to decipher. And let it never be forgotten that, great as has been the recent progress of Geology, the outline of this world-history is little more than sketched, and the headings of its chapters merely indicated. Every observation, then, however local—every fact, however limited—is a contribution of value, the want of which would leave a gap, and might lead to uncertainty or confusion. Let nothing, however trivial it may seem, be undervalued. The ribs and planking of the hull would be nothing without the bolts and trenails,—it was for want of the shoe-nail that the rider was overtaken and slain by the enemy. By closer observation in the Pentlands, for instance, we have still to show the nature of the 'passage' between the Silurian and Old Red. Further information is also needed regarding the conformability of the three great members of the Old Red; how far these indicate separate life-periods; and how far the lower section has organisms in common with the Upper Silurian, and the upper section organisms in common with the Carboniferous formation. Now that the Burdie House, or Lower Carboniferous, series is being so extensively worked for its oil-shales, minuter observation may finally settle the question of its estuarine or fresh-water origin; while, by the same means, we may be enabled to establish the recurrence of estuarine and marine conditions throughout the whole of the Carboniferous system. There is nothing in Geology more interesting than the igneous phænomena of the Coal-formation on both sides of the Firth of Forth; and yet how much of minute bed-by-bed working is required to complete a vivid and reliable picture of the period! Every working geologist feels that there are many points connected with the Glacial Epoch that require elucidation; and where is there a finer field for supplying these desiderata than the Counties of Fife and the Lothians? We are all aware how much the superficial aspects of the British Islands, and, indeed, of the whole world, depend upon denudation in former periods moulding and configuring the hills and valleys; and there is no district, perhaps, in Great Britain that elucidates this view more strikingly than the vicinity of our own metropolis. Again, the effects of upheaval, or rather the oscillations of the earth's crust, are most instructively exhibited in the raised beaches and submarine forests of the Forth; and as observers disagree as to the relative age of these oscillations, renewed observation is still required to put the questions at rest—Whether these upheavals are all pre-human? whether some are not merely pre-historic? others so recent even as the occupation of our country by the Romans? and, indeed, whether the uprise is not still going on? I mention these things out of hundreds that might be indicated, to show how many problems Geology has yet to solve, and how much of the solution lies within our own immediate reach, if we would only not underrate the local because it is near and familiar. But while we duly appreciate the local, let us take care that we aim at something higher than the mere pleasure of a holiday-excursion and the collection of specimens. Collections and cabinets are no doubt indispensable. They are the data upon which we have to found our conclusions, and the facts from which we have to elicit our World-history; but the foolish Greek, who carried about with him a brick as a sample of the building he was anxious to sell, did a wise thing in comparison with the man who fancies that Geology consists in the collecting and labelling of specimens. Without the bricks we cannot have the building, but the bricks have no meaning or symmetry of themselves until arranged according to the design of the architect; neither can specimens of minerals and fossils have significance, save when treated in connection with the general structure of the globe and the phases of its history. Let us strive, then, to combine our labours, whether in the field or in the museum, with the general principles of the science; contented to wait, where we cannot discover the bearings of our isolated facts, but, at the same time, ever endeavouring to arrive at the higher conceptions of a consecutive and intelligible world-plan. It is this that confers on Geology its principal attraction; it is this ultimate attainment of theoretical truth that gives to all the natural sciences their chief importance—leading the Finite and Created to more exalted conceptions of the Infinite and Creative. At present there is no great and all-absorbing topic in Geology; and cultivators are free to follow the bent of their own inclinations, or work out the details of their respective localities. If there is any observable concentration of interest, it is perhaps to the very latest and to the very earliest periods in geological history—to the period when the geological verges into the historical, on the one hand, and to the earliest of all life-periods, on the other,—I mean to deposits containing the earliest indications of our own race, and to metamorphic beds, like the Laurentian—which hold the earliest of yet discovered organisms. To both, the members of our Society may make important additions during their summer-rambles. We have our submarine forests, our raised beaches, our lake-silts, and peat-mosses—all likely to throw light on the early history of our species; and in the metamorphic schists of the Highlands—the serpentines and limestones of Portsoy, Glenesk, Glen Prosen, Glen Tilt, and other localities—additional evidence may be discovered of the existence of lowly life, like that which has recently thrown so much interest around the crystalline strata of the St. Lawrence. And whether successful or not in our researches, the effort will afford most excellent training—training to the eye and reason, and healthful recreation to the lungs and limbs.

Beyond these random allusions, I am not aware of anything in connection with the Society that demands special remark. A fair amount of work has been done during the winter, but that work has been confined to the merest fraction of the Members; and it were exceedingly desirable that many more would follow the example and become what they ought to be—namely, 'working geologists.' A day in the field, under a good instructor, or with a few fellow-members, is worth weeks in the closet; and correct conceptions of natural objects can only be formed by examination of the objects themselves as they occur in nature. Once initiated to the subject, there is no fear of the investigator falling aside. There is sufficient attraction in geological pursuits to keep the hand of the worker at the plough, once his hand is fairly there, and his feet firmly in the furrow;—the subject is so vast and so many-sided—capable of being taken up as a mere recreation or as a laborious study; so replete with practical value, and, at the same time, abounding in problems of unequalled intellectual interest and scientific importance. What the Society desires, therefore, is an increase of its working Members,—an increase in work somewhat commensurate with its increase in numbers. Such are the few scattered thoughts I have to offer in the name of our venerable President, who would have better performed the duty could he have only been induced to make the effort. I know his best wishes are with the Society; and wherever he can aid you, his services are freely at your command. Had he occupied this chair, I know he would have told you, from his matured experience, the many advantages, economic and intellectual, which the study of Geology can confer—economic advantages of which our country, in every department of its industry, is every day reaping the benefit; and intellectual promptings which have led to a newer and deeper insight into the laws and ordainings of nature. I say newer and deeper insight, for with increased knowledge of the past must extend our knowledge of the present; and the tendency of all true knowledge of God's workings in nature must ever be to make men better, wiser, and happier in all their relations to that nature of which they form so prominent a part. On the whole, man's relations may be summed up in three great categories—his relations to external nature, his relations to his fellow-men, and his relations to his Creator. The wider his knowledge of nature, the better will he understand his relations to it; the deeper his understanding of this, the more clearly will he comprehend his relations to his fellow-men; and the more he knows of both of these, the higher and more enlightened will be his conceptions of the duties he owes to his Creator. Let no one, then, attempt to gainsay the obvious tendencies of the natural sciences, and least of all of Geology, which is the sum of all the natural sciences, and the only revelation, when read aright, of God's workings from the beginning in the beautiful and orderly world He has given us to inhabit. Everything is bound up one with another in the divine scheme of the universe; and he who perceives this truth most fully in the physical world, is surely the most likely to regard it in the intellectual and moral. On this ground alone, and altogether independent of its intellectual pleasures and economic advantages, the science of Geology is worthy of our closest cultivation —leading the mind from the harmonies that prevail in the natural world up to the higher harmonies that ought to pervade the human and social. And now, as the evening is advancing, in the name of Mr. Maclaren I must close the business of this session, expressing the hope that we may all meet again in November next, refreshed by our summer-rambles, and instructed by the further knowledge they may have given us of the structure and history of our planet.

THE GEOLOGICAL SOCIETY OF GLASGOW made an Excursion, on May 25th, to Dunglass Hill, Spout of Ballagan on the Campsie Fells, and Finich Glen in the Strathblane district. The party proceeded by Milngavie, and made their first halt at Lochardinnan, near the village of Strathblane, to visit the Sandstone Quarries at that place. The rock there is an ordinary fine-grained Sandstone, much stained in some parts by Oxide of Iron; it is overlain by a thick bed of Conglomerate, the bulk of which is composed of rolled quartz pebbles of various colours, varying in size from 2 to 3 inches in diameter downwards, and the whole loosely cemented in a matrix of fine white sand. This Conglomerate is the only one known to occur in the Carboniferous beds of the West of Scotland. The sandstones with which it is found lie under the limestones and coals of the Campsie district to the east. Some specimens of coal-plants of the genera *Lepidodendron*, *Calamites*, *Sigillaria*, &c., were obtained here from the sandstone below the conglomerate. Mr. John Young, who had kindly consented to act as guide, briefly pointed out the relation of the Sandstone group to the Trap-rock against which it abuts; and although some geologists consider it to be of younger age, he did not think such was the case, from the total absence of pebbles or fragments of trap in the conglomerate. The Sandstone forms a large tract of the eastern part of the South hill, and shows many fine examples of glacial action.

The party next visited Dunglass Hill, a large boss of trap about 150 feet in height, standing isolated in the middle of the valley, between Campsie and Strathblane. The northern front of the rock is bold and precipitous, and passes into a dark fine-grained basalt, which presents a splendid columnary structure in various parts of the hill. At some points the columns are very regular in form, and lie at various angles to the horizon, affording the best example in the neighbourhood of Glasgow of this class of igneous rocks.

On leaving this, the party entered Ballagan Glen, on the north side of the valley, opposite Dunglass Hill, and proceeded to the fine natural section just below the Spout of Ballagan, where the mountain-stream which is the source of the river Blane (which flows westward into Loch Lomond) leaps from ledge to ledge in its descent into the glen. The section here of the so-called Ballagan beds is about 150 feet in height, and consists of no fewer than 230 alternations of thin-bedded nodular limestones (from 1 to 8 inches in thickness), marly shales, and flaggy sandstones of a grey or red colour—the whole forming one of the finest sections in the West of Scotland. Above the thin-bedded limestones are one or two thick beds of a yellowish sandstone; this is overlain by the trap, which forms the whole of the upper part of the hill, and has been very much altered by it. The true age of these Ballagan beds is not yet very clearly established—some geologists referring them to the upper members of the Old Red Sandstone, and others to the Lower Carboniferous—the only fossils as yet found in them being some plant-remains (one a *Lepidodendron*) and obscure Annelide impressions on the flaggy sandstones. In the same beds in the Dumbarton district a few fragmentary fish-scales have been found, but too imperfect for identification. In the Fintry district, one or two very thin seams of coal are said to occur in this group, but none appear in the section of Ballagan. Thin beds of fibrous and compact gypsum are found in them both there and in other localities. The Ballagan beds are evidently intermediate between the Old Red Sandstone—on which they appear to lie conformable—and the Carboniferous strata found farther to the east in the Campsie Valley; and from the thickness of the beds exposed in the various glens along the range of the Campsie Fells, they cannot be less than several hundred feet. Wherever exposed, their characteristics are much the same.

The party then proceeded westward about three miles to Finich Glen—a deep gorge of the most picturesque character, cut by a mountain-stream through great thick beds of the Old Red Sandstone. The scenery of the Blane Valley is, perhaps, unequalled in the West of Scotland. On each side it is bounded by Trap-hills of varied height and form, showing numerous terraced escarpments, many of them finely wooded to the top. In the foreground are the conical hills of Dunfoyne, Dungoyne, and Dungoich, boldly rising from the valley; while in the distance, to the westward, the view is closed in by the heights of Ben Lomond and the other hills of the Grampian range. The gorge of Finich Glen is narrow and deep, and the sides rise vertically from the bed of the stream to the height of nearly 100 feet, and are in some parts only 10 or 12 feet apart, and overhanging. In one part of the glen, a large tabulated mass of sandstone, called the 'Devil's Pulpit,' has been left standing in the bed of the stream. Here Mr. Young made some interesting remarks on the geological features of the district embraced in the day's excursion; and after a hearty vote of thanks had been passed to him for his services on the occasion, the party returned to Glasgow in the evening, highly delighted with the day's proceedings.—J. F.

THE MALVERN FIELD-CLUB have this season devoted the funds at their disposal (arising from the entrance-fees of 1*l.* paid by each Member on joining the Club, and the annual subscription of 1*s.* each) to the opening up of Sections, *Tumuli*, Drifts, &c., under the superintendence of their President, Honorary Secretary, and a Committee. Two sections of Drift have already been opened at a small expense this season. The first was prepared in time for the June Meeting of the Club. The Drifts appertain to Mr. Prestwich's 'high-level series,' and occupy and cover a hill in the Valley of the Severn, between Tewkesbury and Upton-on-Severn, 180 feet above the river, in the grounds of William Dowdeswell, Esq., of Pull Court. These drifts have yielded portions of the tusk of an elephant, a bone of some large pachyderm, and several species of marine shells. The latter have been forwarded to Mr. J. Gwyn Jeffreys for determination.—The second section in the Drift opened by the Club is at Glynch's Mill, near Eastnor. Here the sands and gravels occupy a lower level and rest against the Upper Silurian Rocks (Wenlock Shale), in a narrow valley west of the Southern Malverns. This section was opened at the request of the President (the Rev. W. S. Symonds), who hoped to discover some shells which might determine the question as to the Marine or Freshwater origin of these beds. The result was not so satisfactory as that of the high-level-drift section at Pull Court; for, although marine shells were detected, they were very fragmentary, and might perhaps have been washed out of older deposits. The evidence of ice-action was, however, very interesting. Many large boulders of transported rocks were taken out, which, although they belonged to the Silurian district, gave evidence by their sharp edges that they could hardly have found their way to the nook where they rested among well-rounded and rolled pebbles by any other agency than ice. Mammoth remains were also detected in this deposit.

W. S. S.

OSWESTRY AND WELSHPOOL NATURALISTS' FIELD-CLUB. — This Society met for its Second Excursion this year at Llynclis, near Oswestry, on July 13th. After a brief examination of the margin of the Pool, which is good botanizing ground, the Botanical Section proceeded towards Crickheath and Llanyblodwel Rocks, where they were successful in finding many of the rare ferns and other plants which make these rocks their *habitat.* The Geological Section visited, first, the lower beds of the Carboniferous Limestone at Porthywaen, where they obtained specimens of *Cyrtinia carbonaria*, *Productus Llangollensis*, and *Murchisonia Verneuiliana.* They then proceeded to examine the fossiliferous Lower Silurian Shales which at this point underlie the Mountain-limestone, and are exposed on the road leading from Porthywaen to Treflack. A cutting in a branch railway which is in the course of construction up the Nant Mawr afforded another section of these Shales, and showed their unconformability to the Mountain-limestone. From this point the Members returned along the line of a great fault to the old quarries in the Mountain-limestone at Wern, where examples of several species of *Lithostrotion* and *Diphyphyllum* were found, both in such a state of preservation as to exhibit their internal structure, and to show that the latter is not, as some authors suppose, only a species of the former genus. The return route now lay along the junction of the Mountain-limestone with the Millstone Grit; and a very limited search served to justify the reputation for fossils which the latter formation has now gained in this district.

The Club met for dinner in the 'Tower' on the top of Sweeney Hill. After dinner, several new Members were elected, and it was decided, in addition to the Meeting intended to be held at Llangollen in August, to have an excursion to Westbury in September. A visit was then paid to the quarries in the Millstone Grit on the west side of Sweeney Hill; and in the one nearest to the Tower, the line of fault to which the hill owes its elevation was well seen. In the next, the uppermost beds of Grit were seen dipping unconformably under the Coal-measures; and from some of the highest beds were obtained numerous specimens of *Productus semireticulatus*, var. *Martini*, associated with Calamite-stems and a unique example of a large Annelid, together with many Fucoids. Some attention was next paid to the 'Pockets' which occur in the thick Sandstone-beds. The character of the beds downwards to the subjacent Mountain-limestone was noticed as fully as time would allow, and the horizon of the various fossils hitherto discovered was pointed out by one of the Members. The branch railway before referred to cuts through the formation in a line nearly coincident with its dip; and the Members present were able to traverse the whole series, and to verify the fossiliferous nature of the lower beds. Thus terminated a very pleasant and instructive excursion. —D. C. D.

CORRESPONDENCE.

To the Editor of the GEOLOGICAL MAGAZINE.

DEAR SIR,—A few days ago, I observed at the Talargoch Mine, near Prestatyn, Flintshire, a very curious, and, as I believe, unusual form of quartz, which, I think, is worth noticing in the Magazine.

The mine is situated at the foot of a bold escarpment of Mountain-limestone forming the western termination of one of the great limestone ranges that run through Denbighshire and Flintshire. Most of the lodes occurring in the black shales and limestones at the base of the Carboniferous series run ENE. by WSW., and contain sulphurets of lead and zinc in a matrix of quartz and calc-spar. One of the lodes running east and west, nearly vertical, and from three to six feet in width, is almost entirely occupied with silicious sand of the most perfect purity and lustrous whiteness. Just at the side of the lode, at its junction with the limestone, a little calcareous and quartz-spar occurs, which, in a few places, runs into the body of the lode; and an isolated nodule of spar, with a little galena, is occasionally found: but otherwise the whole lode is a mass of homogeneous and fine-grained sand, soft enough to be friable under the miner's 'pick,' and when dry quite incoherent, breaking up into fine dusty particles. A gradation between this white sand and the regularly crystallized quartz is occasionally met with in the form of white saccharoid spar; and it would be difficult to determine whether this sand-lode is merely decomposed quartz, or a segregation of silica that had never attained complete crystallization. The lode near the shaft at the foot of the escarpment is worked by a level about 125 feet deep; it appears to thicken, and the sand increases in purity and freedom from crystalline spar to the east, where, under the limestone range, it is much farther from the surface. I am informed that the late Mr. Hewson, Analytical Chemist, of Liverpool, could detect no trace of metallic oxide or other foreign matter, and ascertained the sand to be absolutely pure silica with a little water. I enclose some of the sand for your inspection: it is, without exception, the whitest mineral I have ever seen, and should think such a perfectly pure form of native silica would be of great value in the manufacture of the better kinds of glass and pottery.

I remain yours very truly, GEORGE MAW.

BENTHALL, BROSELEY: *June* 19, 1865.

P.S.—As I recently described, in the pages of the Magazine, some deposits of sand in cavities in the Mountain-limestone of the same district, I would state that they are of a totally different age and character to the sand in the Talargoch Mine lode. I have recently observed, over a large district of Flintshire and Denbighshire, a great extension of the white sand and clay deposits, older than the boulder-clay-drift, similar to those at Llandudno.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—The President of the Geological Society, in his able address which appears in the 'Journal' of the Society for May 1865, in noticing my Memoir on 'the Geology of the Country around Oldham, including Manchester and its Suburbs,' makes a strange—I might say hap-hazard—supposition, which it is only due to him, the Geological Survey, and myself, should not be allowed to pass without notice.

In recounting the succession of the formations in the neighbourhood of Manchester, as described in this Memoir, the President says, 'Above them' (the Coal-measures) 'come the Permian Rocks, consisting of Lower Permian Sandstone and Upper Permian Marls; and these again are overlain by the Pebble-beds, or Conglomerate of the New Red Sandstone or Trias.

'No fossils are mentioned as occurring in this Conglomerate; but as it is described as conformable to the underlying Permian, with an inclination of about 10° to the south-west, they (*sic*) may possibly turn out to belong to the Permian series, like the Sandstones described by Sir R. I. Murchison at St. Abb's Head in Cumberland, and then the Trias would be here wanting altogether!'

Now, in the first place, St. Abb's Head is not in Cumberland, nor even in England; and doubtless the President means St. Bee's Head. But, under this supposition, I may state, in the first place, that there is no similarity whatever between the St. Bee's Head Sandstone and the Pebble-beds or Conglomerate in the neighbourhood of Manchester above referred to; and even supposing that it had been conclusively established that the former is of Permian age, it would not in the least affect the question of the Triassic age of the Lancashire Pebble-beds.

As regards these latter, which consist of brownish-red sandstones, with pebbles of coloured quartz scattered throughout their mass, there has never been any question even amongst the most ardent *Philo-Permianists*; and they have been correctly described as Triassic by Ormerod, Binney, and all other good geologists who have examined the country. An experience of some twelve years in working out the Triassic and Permian formations of the midland and north-western counties enables me to confirm their views. These Pebble-beds are the equivalents of the quartz-ore Conglomerates of the central counties, which frequently constitute the only representatives of the Bunter Sandstone; and if they are not of Triassic age, then there is no Lower Trias in England, or in Europe, or indeed anywhere; and the Permian Empire must spread its broad ægis far beyond its present bounds! This, however, is out of the question. The Pebble-beds, and the Lower Red and Mottled Sandstone, which form the lowest division of the Bunter, lie discordantly with reference to the Permian Beds throughout; and, in the neighbourhood of Manchester, any conformity which may exist is only local and accidental. Discordance is the rule, the reverse the exception, all along the margin of the South Lancashire Coalfield; and if Mr. Hamilton will come down here, I shall be very happy to show him that the Pebble-beds cannot 'turn out to belong to the Permian series.'—I am, Sir, faithfully yours, EDWARD HULL.

GEOLOGICAL SURVEY OF GREAT BRITAIN,
MANCHESTER: *August* 3, 1865.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—With reference to a short paper on a supposed 'Pre-Cambrian Island,' read by me at the British Association last year, and inserted in your Magazine for December last, I have to beg you to apply a *caveat*. I did not, I hope, speak at all dogmatically on the point to which I could give but a very moderate degree of attention; but knowing of how great interest the fragments of old *Pre-Cambrian* land are to geologists, I did try to draw some of my friends who have the leisure to that neglected locality, St. David's. The result has justified my endeavour, if it has not turned out exactly as I could have wished. The Rev. W. S. Symonds and the Rev. H. H. Winwood, of Bath, visited the spot this year, attracted by this notice, and they saw some reason to doubt the correctness of the suggestion I made—'that the Syenite-ridge of St. David's was a portion of the old land of which the Hebrides, parts of the north-west coast of Ireland, and the Malverns, are fragments.'

My supposition has now been tested by the close observation of my friends just mentioned, and my colleague, Mr. H. Hicks. Like myself, Mr. Hicks at first paid far more attention to the fossiliferous beds *above* the Cambrian, than to the metamorphic or igneous rocks at their base. But his keen eye and good hammer, once turned to the point, he has I think, proved that I was in error, by finding portions of the schist entangled in the syenite-trap.

I know that the last edition of the Geological Survey Map represents the rocks as altered on the north side, and unaltered on the south. There can hardly be this difference. My friend Mr. Hicks believes there is alteration on the south side too; so both authorities are against me at present. There are plenty of sections, but so many cross-faults which require to be allowed for, before even the true succession can be established, that I cannot admit that I am beaten until the syenite has been thoroughly examined on both flanks; and I can only hope good observers will go again and again to this interesting point. The last edition of the Survey Map confines the syenite to St. David's and its neighbourhood; while it makes the trap of Ramsey Island a greenstone, similar, I suppose, to that of St. David's Head, and altering similar rocks. We may assume that it is a continuation of the St. David's trap, as I ventured to do in my paper. But if the trap and schists of Ramsey Island be really quite different from those of St. David's, opposite, an unmarked fault, N. and S., of no little magnitude, must occupy the Sound. The whole thing, therefore, wants investigation. Who will do it? I am quite certain, whoever does will have the cordial co-operation of my friend Mr. Hicks; and I really have no time to find out my own mistake, if it be one. Altered rocks are crotchetty things to deal with; and a sharp anticlinal like that of St. David's does not take place without many a parallel fault which may bring the unaltered rock against the trap, and deceive others, as it appears to have deceived

Yours truly, J. W. SALTER.

ON THE FOSSILS FROM THE SILURIAN SHALES OF MOFFAT, DUMFRIESSHIRE.

MY colleague Mr. Carruthers, and Mr. Young of the Hunterian Museum, Glasgow, having called my attention to the communication of Mr. Brown (*ante*, p. 382) regarding his discovery of fossils in the Moffat Graptolite Shales, I have, through the kindness of Mr. Brown, been permitted to examine his specimens. I submitted them to Mr. Carruthers, who is acquainted with the beds from which they were obtained, and he has supplied me with the following notes regarding the fossils and the strata.

Besides the Graptolites which abound in these shales, there have been found two species of a phyllopodous crustacean, *Peltocaris*, described by Mr. Salter in the 'Quarterly Journal of the Geological Society,' vol. xix. p. 87, viz., *P. aptychoides*, Salt., and *P. Harknessi*, Salt. Prof. Harkness has found specimens of the small brachiopod, *Siphonotreta micula*, M'Coy (Cat. of Fossils in Mus. of Pract. Geol., p. 17). Mr. J. Stevens, for some time an enthusiastic explorer of the Moffat Shales, discovered a single specimen of *Tentaculites*. The lighter coloured arenaceous deposits of Hunterbreck Hill contain the impressions of *Crossopodia Scotica*, M'Coy; *Nereites Cambrensis*, M'Coy, and other Annelids (Murchison's 'Siluria,' p. 199). These organisms, together with the Graptolites, have caused the Moffat Shales to be referred without doubt to the Llandeilo Flags.

Mr. Brown's fossils are, however, a very interesting discovery. They are not Molluscan, but Crustacean, being the remains of a phyllopodous animal that cannot be referred to any described genus. It is more nearly allied to *Dithyrocaris* than to *Peltocaris*, which is found in the same deposits. One specimen is preserved, so as to exhibit the dorsal aspect of the whole carapace, which is in one piece, with the exception of the separate rostrum, as in *Dithyrocaris*. The round carapace, marked by concentric rings of growth, might be easily mistaken for a *Discina*. Several specimens are compressed laterally, and exhibit only the half of the carapace, having the appearance of an *Estheria*, or even of a *Modiolopsis*.—H. W.

MISCELLANEOUS.

The vast Wealden formation at the back of the Isle of Wight, between Black Gang and Brooke, has long been celebrated for the great variety and wealth of its fossil remains. Numerous bones of Reptiles have been found in this formation near Brooke, principally belonging to that enormous lizard, the Iguanodon, which, with the Megalosaurus, Hylæosaurus, and other extinct monsters, passed their lives on the banks of this great Wealden river. Within the last few days, the Rev. W. Fox, of Brixton, near Brooke, well known among palæontologists for his labours in this branch of geology, has discovered in these beds a new reptile of the Dinosaurian family. The only parts of the skeleton wanting are the head and neck. The animal was above six feet long from the shoulder to the rump, and was furnished with a massive tail five feet long. The legs were about four feet in length, terminating in a broad, short foot. One of the most remarkable features of this strange reptile is the manner in which it is clothed in bony armour. Plates of bone from half an inch to four inches in diameter, and about half an inch thick, covered its body, with the exception of its back, which was protected by a great bony shield. Another remarkable characteristic of this animal was a very curious process of spine-like bones, which ran along the body and the tail, some of which are fifteen inches long, and weigh seven pounds. The remains of this extinct monster were examined last week by Prof. Owen, as well as the Wealden formation from which they were extracted; and we understand that, with reference to the extraordinary nature of the spine-like bones to which we have alluded, Prof. Owen is of opinion that the most appropriate name for this new Saurian would be *Polacanthus*.—*Athenæum*, August 5.

THE

GEOLOGICAL MAGAZINE.

No. XVI.—OCTOBER 1865.

ORIGINAL ARTICLES.

I.—On an Undescribed Cone from the Carboniferous Beds of Airdrie, Lanarkshire.

By William Carruthers, F.L.S., of the British Museum.

(Plate XII.)

SMALL disc-shaped bodies have frequently been noticed in coal and the accompanying shales. Specimens were figured by Mr. Prestwich in 1840, in his paper on the Geology of Coalbrook Dale (Geol. Trans., Second Series, vol. v., tab. xxxviii., ff. 8, 8a); and Professor Morris, who described Mr. Prestwich's fossils, characterises them as 'capsules' of his *Lepidodendron longibracteatum.** But it does not appear from either the illustrations of the two spikes of his species, or from the letter-press, that he had found the capsules associated with the reniform thecæ of the spikes. Prof. Balfour has also figured and described similar bodies in a paper read before the Royal Society of Edinburgh in 1854. He found them in the 'splint-coal' of Fordel, near Inverkeithing, in Fife. He says, 'Besides Sigillarias and Stigmarias, we also detect in the Fordel Coal peculiar rounded organisms which have the appearance of seeds. Dr. Fleming informs me that similar bodies have been observed by him in coal, and that he exhibited them to Mr. Witham about twenty years ago. They have also been seen by Dr. Fleming in Lochgelly and Arniston "parrot," and in the coal at Boghead; and from having observed them in "cherry," "splint," and "cannel" coals, he is disposed to consider them as a somewhat common feature. I have seen them in coal from Miller Hill, near Dalkeith, as well as in the coal from Fife. They appear to be certainly allied to the fructification of the *Lycopodiaceæ* of the present day, more particularly to that form of it which consists of two valves placed in apposition and containing what is called Lycopode-powder. These and like bodies I, therefore, consider to be the sporangia or spore-cases of some plant allied to *Lycopodium*, perhaps *Sigillaria*. The valves present under the microscope a reticulated surface, and minute granular matter seems to be attached to the inner surface.'—(Edin. Trans., vol. xxi. p. 191).

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* Prof. Morris referred this plant to *Lycopodites* with a query: he now considers it a true *Lepidodendron*.

Not only do these bodies exist in quantity in many coals, but some beds even of considerable thickness are almost entirely made up of them.* Their relation, however, to any organism that could have produced them was unknown until the discovery of a cone by Mr. James Russell, of Airdrie, a diligent and intelligent collector of Carboniferous fossils. Mr. Russell, aware of the importance of his discovery, gave me the specimen for description. It consists of the lower portion of the cone, very much compressed, as so many of these fossils are, in a layer of highly bituminous shale or impure coal. The fragment is 2¼ inches long, and the cone is fully three-quarters of an inch broad. The axis and scales are converted into coal, and the scales are covered with a double series of round flattened bodies of a dark-brown colour. The axis occupies about a fifth of the diameter of the cone. In the fragment thirty scales rise from either side of the axis, and an examination of the scars on the surface of the axis satisfies me that there were ten scales in each whorl. The lower half or pedicel of the scale is at right angles to the axis, except at the base of the cone, where a few of the scales are inclined downwards, this inclination increasing as they near the base. The pedicel forms a broad and somewhat firm support for the sporangia. The apex of the scale is long, slender, and foliaceous, overlapping several scales, and reaching at least beyond the base of the fourth above it. The horizontal portion of the scale supports a number of sporangia, varying from ten to eighteen, placed in a double series throughout its length. The sporangia are generally flattened, and appear like small discs; but sometimes the two walls are separated, as shown in fig. A 8. Professor Balfour figures a specimen which more nearly approaches to a sphere. They were most probably more or less flattened spheres; smooth above, but with a triradiate ridge below, by which they were attached to the supporting scale (figs. A 5 and A 7). This ridge is formed by a simple bending down of the wall of the sporangium, and it produced a corresponding triradiate depression in the interior. A slight difference of texture is apparent on the spore-case, producing a faint line which unites the extremities of the ridge in a curvilinear triangle. The sporangium is unicellular, and is composed probably of a layer of large elongated cells, their long axis forming the thickness of the spore-case, as in recent *Lycopodiaceæ*: the large cells have given the sporangium a finely granulated texture. The surface of many specimens is covered with prominences produced by grains in the interior, for a careful examination shows that the texture of the sporangium is continuous over the protuberance. These prominences are seen in the sporangium fig. A 5, and more marked specimens occur in a broken case which I have figured at A 6. They are strikingly shown in Mr. Prestwich's illustration. Supposing that these might be spores, I had several thin sections of a shale in which the sporangia abound prepared; but I have not been able to discover, in the numerous sporangia I have examined, any structure like a spore. This, however, undoubtedly arises from the manner in which the bodies are preserved. Prof. Morris accurately describes them as being 'neither bituminized nor mineralized, but in a state of brown vegetable matter.' The external form, and even the cell-markings on its surface, are beautifully preserved in the mould of shale which was deposited around them; but no internal structure exists. A change similar to that produced in animal bodies when they are converted into adipocere has taken place in them; and they are converted into a hydrocarbon of an orange-brown colour when seen by a reflected light, and of a texture like solid paraffine. It is remarkable that while the axis and scales of the cone are converted into coal, the sporangia should be changed into so different a substance: and this is the condition in which they appear always to occur. The specimens obtained from coal and shale which I have examined, the examples from the splint-coal of Fordel described by Prof. Balfour, and those from coarse sandstones of Coalbrook Dale, described by Prof. Morris, are all in the same condition. Prof. Balfour suggests that the organic mineral called by the late Prof. Johnstone, of Durham, 'Middletonite,' may be derived from these sporangia. This mineral was originally obtained in very thin layers, or in small round particles, in the main-coal at Middleton, near Leeds. It occurs so abundantly both in layers and in granular pieces in the Fordel coal, as to give a peculiar rusty-brown aspect to the coal. This substance was observed more than forty years ago by the late Dr. Fleming in the 'splint-coal' of Balbirnie, in Fife, and afterwards in coal from Clackmannan; and he believed that certain veins of a rich wine-yellow which occur in Boghead coal were the same mineral. All the sporangia which I have had sliced show a perfectly uniform structure throughout, and this substance exactly agrees in its physical properties with 'Middletonite' as described by Johnstone.

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* Mr. Binney informs me that he is acquainted with a stratum of coal, some six feet thick, almost entirely made up of these bodies.

The cavity of the sporangium is filled with a dark amorphous substance similar to the body of the rock in which the discs are found. Prof. Balfour considers this black carbonaceous matter to be the altered sporules, and corresponding to the Lycopode-powder of recent *Lycopodia.*

Having described this singular fossil, there are two questions that we shall examine: first, the relation this cone bears to the different specimens of *Lepidostrobi* that have already been described; and, secondly, the affinities it has to the living vegetable kingdom.

The great majority of specimens of *Lepidostrobus* are found flattened and carbonized, and so exhibiting the forms of the cone without any structure. Some examples found in nodules in shale are preserved in the round, showing the external form and the arrangement of the larger organs. Such cones are figured by Lindley and Hutton in their 'Fossil Flora;' but as the sulphide or carbonate of iron into which they are converted is only a cast of the organism, and does not exhibit structure, it is impossible to determine with certainty their affinities with recent vegetables. The conclusion of the authors referred to seems to have been, on the whole, that they were Coniferous; although sometimes they lean to the opinion that they are Lycopodiaceous, or somewhere intermediate between the two families. The materials which Brongniart had to work with, though more extensive, were not in a better condition. In the second volume of his 'Histoire des Végétaux Fossiles' (unfortunately imperfect), he enters into an elaborate examination of their affinities, and shows that they are nearly related to *Lycopodiaceæ*, even though he was ignorant of the contents of the organs borne on the scales. In the text he describes the sporangia as attached to the under surface of the scales, showing an affinity, as he supposes, to Ferns; but in the magnified illustration of two scales and the related sporangia, he places them rightly, as is evident from the imbrication of the apices. The misconception probably arose, as Dr. Hooker suggests, from his mistaking the base for the apex in the cone to which the two magnified scales belong. (*Op. cit.*, pl. xxiii., figs. 2 & 2 *b*.)

Robert Brown had the singular good fortune to obtain in 1843 the upper half of a silicified cone, which, when prepared, for the first time exhibited not only the arrangement of the different parts, but their microscopic structure,—and, what was of much more importance, showed that the seed-like bodies, supported by the scales, were sporangia filled with spores composed of three, rarely of four, sporules. The value of this fossil was shown by Mr. Brown in his communication read to the Linnean Society in 1847, and published with drawings in the 20th volume of their 'Transactions' (1851). He named it *Triplosporite*; thereby expressing its fossil state, the class or primary division to which it belonged, and its supposed peculiarity in structure. In regard to its affinities, he considered that it agreed in its scalariform vessels with all the fossil genera supposed to be acotyledonous, in the structure of its sporangia and spores with *Lycopodiaceæ* and *Ophioglosseæ*, and amongst fossils with *Lepidostrobus*, from which, however, it differed, according to Brongniart's elaborate Memoir, which Mr. Brown accepted as accurate, in the manner of the attachment of the sporangium to its supporting scale.

In 1848, Dr. Hooker published a valuable Essay on Lepidostrobus, in part ii. of the 2nd volume of the 'Memoirs of the Geological Survey of Great Britain' (p. 440). From the examination of a large series of sections from different cones, he made out their structure, and the nature and contents of the sporangia, and thus independently confirmed what Brown had determined from a single cone. He further showed that Brongniart's notion that the sporangium was borne on the under part of the scale was incorrect, and so set aside the most remarkable difference between Brown's *Triplosporite* and *Lepidostrobus*. In a note appended by Brown to his paper published in the Linnean Society's Transactions, after the publication of Dr. Hooker's Memoir, he withdrew his name *Triplosporite* (which, however, had already been taken up by Unger in his 'Genera et Species Plantarum Fossilium' from the published abstract of the paper), and reduced his genus to *Lepidostrobus.*

That *Lepidostrobus* is the fruit of some species of *Lepidodendron* there can be no longer any doubt, and it would seem better to reduce the first genus, which is based upon only a fragment of a plant. But there are reasons which appear to me sufficiently important to retain this as at least a temporary genus. The *Lepidodendra* seem to have been very brittle plants: the stem, branches, and fruit were easily snapped asunder, so that they almost always occur in a very fragmentary condition. A cone is very rarely found connected with its supporting branch. The evidence, therefore, of the connection between a *Lepidodendron* and its own Lepidostrobus is consequently of a very unsatisfactory nature. The two kinds of cones described by Dr. Hooker were found enclosed in hollow trunks, the one of *Lepidodendron elegans*, and the other of *L. Harcourtii*; and on this ground he refers them to these two species. Until materials turn up to satisfactorily determine the relation of fruits to their own species, it will create less confusion, and supply more definite data, if we consider *Lepidostrobus* in the meantime as a genus. We may hope, in course of time, to be supplied with such specimens: a few have been already published by Lindley, Patterson and Prestwich.

Lepidostrobus is a cylindrical, obtuse cone, somewhat tapering at both ends, and variable in length. It consists of a solid central axis, supporting numerous scales, each bearing a single oblong sporangium. The axis is cylindrical, and is composed of a small core of cellular tissue, surrounded by a sheath made up of numerous bundles of scalariform vessels, scattered at regular distances through a tissue of elongated cells. These gradually leave the axis, and each forms the vascular bundle of a scale passing along its centre to its apex. The lower half or pedicel of the scale is at right angles to the axis, and the imbricated apex has a direction more or less parallel to the axis. A single sporangium is supported on the upper surface of the pedicel, and is either adnate, or attached by a small surface towards the apex. The sporangium is an oblong tapering body, largest at the outer extremity. The spores are composed of three, rarely of four sporules, which at last separate from each other.

This description is illustrated by figures B and C, Plate XII. Fig. B shows transverse and longitudinal sections of part of a cone, and the spores of *Lepidostrobus Brownii*, drawn from Mr. Brown's specimens in the collections of the Botanical Department of the British Museum. Fig. C is a restored section of two scales, and the spores of *L. ornatus* from Dr. Hooker's plate in the Geological Memoirs (*loc. cit.*, pl. v. and viii.).

The cone I have described differs remarkably from *Lepidostrobus* in the large number of small sporangia borne on each scale. At first I was inclined to consider this as only of specific value, but it now seems to me that it would be under-estimating the importance of this singular structure were I to place the cone in *Lepidostrobus.* I therefore propose to establish a new genus, and to associate it with the name of the late Prof. Fleming, who was the first to draw attention to the detached spore-cases; and I do this the more heartily, as I ever recall with gratitude and delight the lessons in the class-room, the study, and the field, which I received from one who was unsurpassed as a careful observer and exact interpreter of nature. The two genera are thus contrasted:—

Lepidostrobus.—Each scale of the cone supporting a single oblong sporangium.

Flemingites.—Each scale of the cone supporting a double series of roundish sporangia.

F. gracilis.—Cone slender, cylindrical, very slightly tapering at the base, composed of a solid axis and numerous imbricated scales, ten in a whorl. The apex of the scale long and slender. Sporangia attached by a triradiate ridge.

The affinities between the fossil *Lepidostrobus* and recent plants have been illustrated by Brongniart, Brown, and Hooker. In the minute structure of the axis and scales, in the arrangement of the parts, and the relation the sporangium bears to the supporting scale, there is nothing to separate it from *Lycopodiaceæ.* I have placed on the plate a magnified section of a small cone of the well-known and widely-distributed *Lycopodium cernuum*, a species which sometimes attains a height of 6 feet, and has the aspect of a diminutive *Lepidodendron.* A glance at the drawing (fig. D) will show that the general resemblance is very striking. The cone of *Flemingites*, however, introduces a structure more removed from the recent *Lycopodiaceæ*; but a little examination may convince us that this is not so abnormal as at first sight appears. The sporangia of *Lycopodium* are generally described as axillary, and for all practical purposes this is quite satisfactory; but they are really supported on the scale as shown in the section of the spike of *Lycopodium cernuum.* Even in species where the sporangium seems to be really axillary, it always separates with the scale when that is torn from the fresh plant. In *Tmesipteris*, an Australian Lycopodiaceous genus, the relation of the two-celled sporangium to the leaf is very obvious. The attachment, then, of the sporangium in *Lepidostrobus* may be considered the normal arrangement in *Lycopodiaceæ*, and the difference between that genus and *Flemingites* is only the increased number of sporangia on each scale.

A monstrosity in *Equisetum* described by Milde, and an interesting specimen of which is in the possession of Mr. Clarke, who called my attention to it, deserves to be noticed here, as it seems to me to throw light on these fossil cones. Mr. Clarke's specimen is *Equisetum limosum.* It has the annulus at the base of the spike converted into a large-toothed foliaceous membrane, and some of the teeth bear one or two sporangia on the surface near the apex. The sporangia are exactly like those on the scales of the spike. Milde describes specimens where the annulus is converted into a true sheath, similar to those on the stem below. It would appear, from these two monstrosities, that the annulus and peltate scales of the spike are altered sheaths—or, that is to say, leaves. The scales support numerous sporangia round their margin. If in a spike the scales were to assume the leaf form, and to bear the numerous sporangia on their surface, the spike or cone would exhibit an arrangement similar to that in *Flemingites.*

I have excluded the contents of the sporangia from the points of similarity existing between *Lepidostrobus* and *Lycopodiaceæ*, because these exhibit other affinities. The sporangia of *Lycopodiaceæ* contain a fine powder composed of minute free bodies which ultimately produce spermatozoids, with the exception of *Selaginella,* which has two kinds of sporangia—one having contents similar to the other genera of the family, and the other containing three or four true spores, called *oophoridia.* The sporangium of *Lepidostrobus Brownii,* on the other hand, is filled with immense numbers of true spores; and if I am right in supposing the prominences on the sporangia of *Flemingites* as produced by spores, it agrees with *Lepidostrobus* in this respect, and both would be, as regards the sporangia, allied to *Isoetes.* But there exists in the beautifully silicified specimen of *L. Brownii* a quantity of minute granular matter, which I am inclined to consider as the minute spermatozoid-producing bodies which fill the sporangia of *Lycopodium,* and those on the inner leaves of *Isoetes,* but which are found in the same sporangium with the true spores in *Rhizocarpeæ.* While, then, the more obvious characters in the structure of the cones ally these two genera to *Lycopodiaceæ,* the contents of the sporangia (a characteristic in regard to living plants considered of the first importance) place them nearer to *Rhizocarpeæ.*

POSTSCRIPT.—Prof. Balfour, in a note to his paper, alludes to the discs which occur in the 'Resiniferous shale' from the River Mersey, on the north side of Tasmania, and considers that they are probably the same as the sporangia of *Flemingites.* By the kindness of Prof. Church, I have obtained some specimens of these discs. They exist in the same abundance in this shale,—forming 30 to 40 per cent. of the rock,—as the sporangia of *Flemingites* do in some coals and shales which I have examined. They are converted into a hydrocarbon, into the composition of which, however, a little over 5 per cent. of sulphur enters. To this singular organic mineral Prof. Church has given the name of Tasmanite. (Phil. Mag. 1864, p. 465.) The discs differ from the sporangia of *Flemingites* both in structure and size. Although composed of two walls which are still separable, they contain nothing in their interior, so that they appear quite homogeneous. The sporangia of *Flemingites* have a diameter of from 5 to 7 hundredths of an inch, while the discs of Tasmanite which I have measured vary from 1½ to 2 hundredths of an inch.

I know of nothing in the vegetable kingdom to which the enormous abundance of these organic bodies in some deposits can be compared, except the so-called 'sulphur-showers' produced by the shedding of the pollen in extensive pine-forests in Scotland and Norway.

EXPLANATION OF PLATE XII.

Figs. A. *Flemingites gracilis.*—Specimen natural size. 1. Ideal longitudinal section of a portion of a cone. 2. Ideal transverse section of the quarter of a cone. 3. A single scale, showing the number and arrangement of the sporangia—magnified five times. 4. The upper surface of a sporangium. 5. The under surface, showing the triradiate ridge. 6. Fragment of a sporangium, exhibiting the prominences on its surface. 7. Section of a sporangium through the ridge. 8. Another section. Figs. 4–8 greatly magnified. 9. A fragment of coal almost made up of sporangia. 10. Portion of a *Sigillaria*, with a considerable quantity of sporangia covering one side of it.

Figs. B. *Lepidostrobus Brownii.*—1. Longitudinal section of the upper portion of the cone. 2. Transverse section of a quarter of the cone. 3. Sporangia. From the specimens in the collection of the British Museum.

Figs. C. *Lepidostrobus ornatus.*—1. Restored section of two scales and a sporangium (from Hooker's Memoir, pl. viii. f. 11). 2. Sporangia (*loc. cit.*, pl. v. f. 9).

Fig. D. *Lycopodium cernuum.*—Transverse section of the cone.

II. On some supposed Ice-scratches in Derbyshire.

By A. H. Green, M.A., F.G.S.

In the number of the Geological Magazine for last August, in a letter from Mr. Mackintosh, there is a notice of some markings, supposed to be glacial, on a rock known as 'The Bloody Stone,' between Cromford and Bonsall, in Derbyshire. Mr. Mackintosh's language is not very clear, but I rather gather that he has doubts whether these markings were really made by ice: nor does he seem to be aware of the great interest that would attach to the discovery, if it could be proved beyond question that we have here a true ice-marked surface of rock. It is, I believe, very generally the case that the deposits and, so to speak, footmarks of the Glacial epoch are found on the western side of the central axis of the north of England in much greater force than on the eastern side. Thus much I can say from personal observation: in North Staffordshire and Lancashire, boulder-clays and gravels are found stretching from the plains far up the hill-sides, and erratic blocks lie here and there upon the moors to a height of 1,400* feet above the sea. On the other side of the so-called Pennine Chain, however, the case is widely different: throughout the whole of North Derbyshire and the adjoining uplands of Yorkshire there is nothing that can be safely set down as Drift, and certainly no blocks or pebbles of foreign rocks over the country to the north of the Wye. The valley of that river cuts right across the Great Saddle; and along it, and to the south of it, we do find stray patches of clay with ice-scratched boulders, mostly of limestone, but here and there of granite, greenstone, and other strangers, which seem to have found their way from the west along this sole opening in the barrier which elsewhere blocked up their path. 'The Bloody

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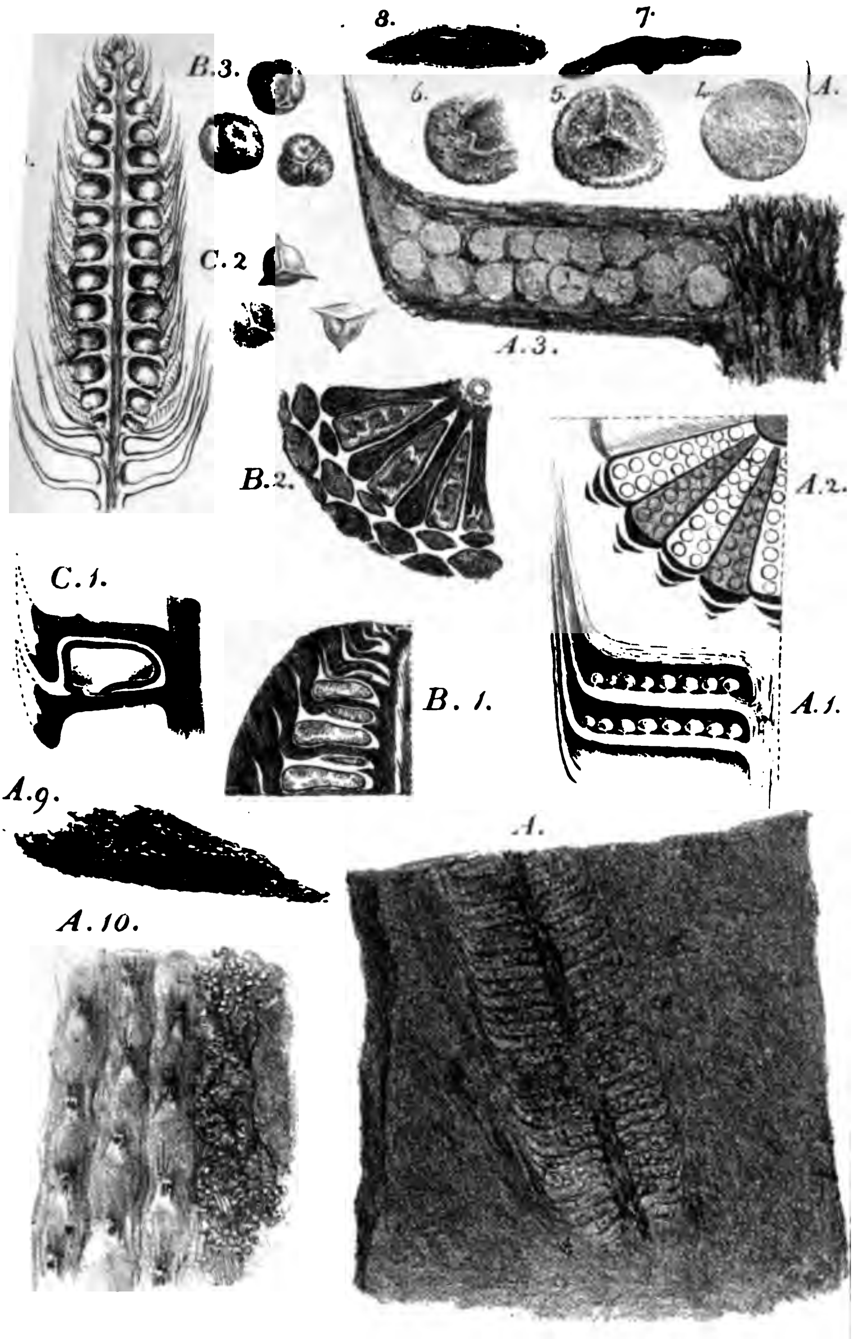
[*] Sir H. De la Beche gives 1,800 feet as the limit of erratics: I here speak only of what I have seen myself.



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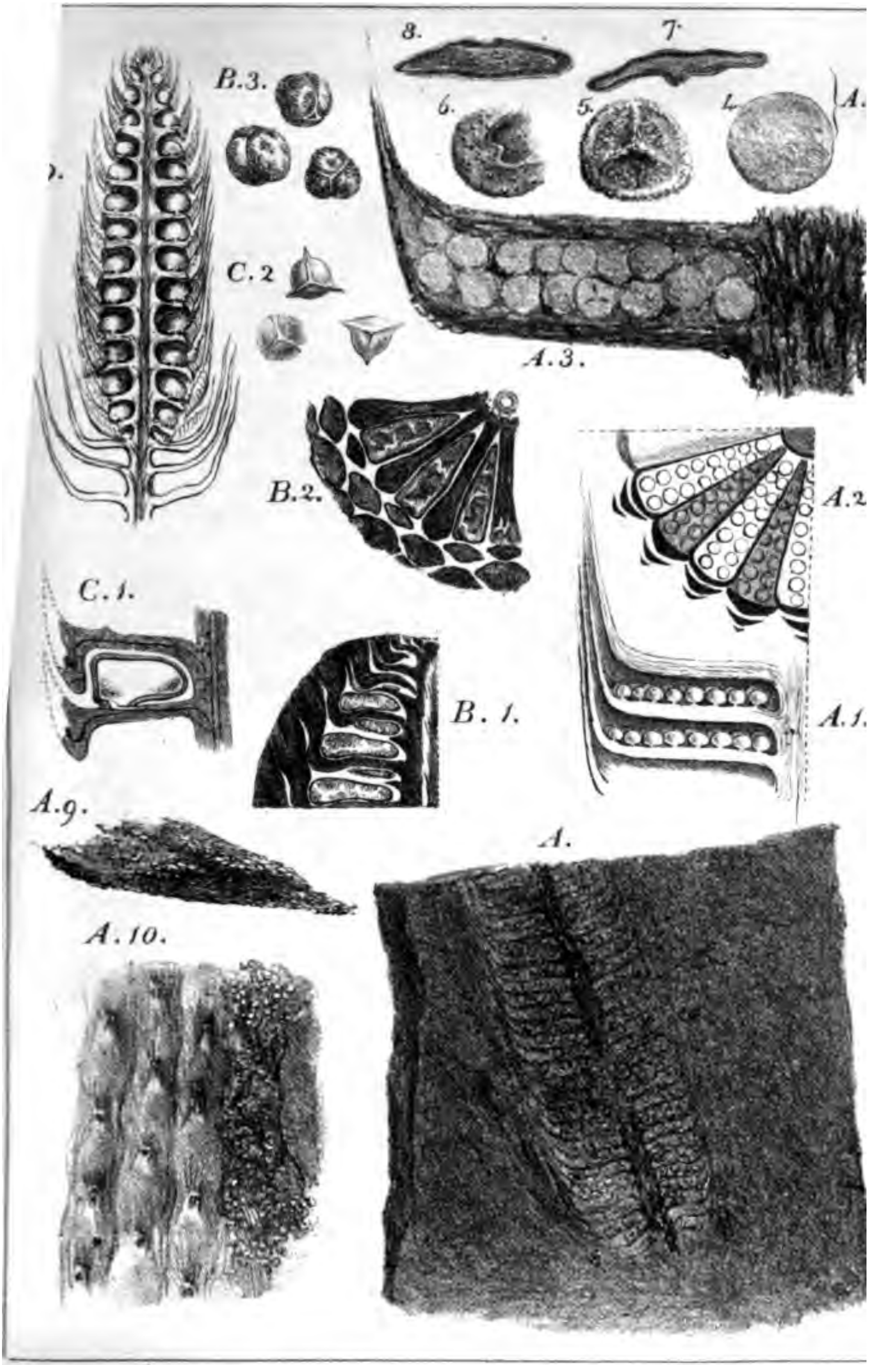
FLEMINGITES & LEPIDOSTROBUS [illegible]



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Stone' is just a case in point, lying as it does in the valley of the Derwent, about seven miles below the junction of the Wye with that river. I was, therefore, extremely glad to see Mr. Mackintosh's letter just in time to pay a visit to the spot, and I shall tell as carefully as I can what I there saw, in hopes that more experienced ice-men, if they cannot go to see for themselves, may be enabled to decide whether we can fairly refer the markings in question to the action of ice.

The spot is easily found. A bridle-road leads over the hills from Cromford to Bonsall, and following this we reach on the crest of the ascent, just below where the word 'Rugs' is written on the Ordnance Map—a boss of limestone studded with dark-red patches, whence its name of 'The Bloody Stone.'* These patches are of chert, polished down to a smooth surface, and scored over with grooves and scratches. At first sight it looks as if the limestone was covered with a very thin layer of chert, which has here and there been worn or weathered off; but closer examination shows us that each patch is the section of a chert-nodule imbedded in the rock, the upper part of which has been ground away (see fig. 3). Fig. 1 is a ground-plan, and fig. 2 a section of the rock, both on a true scale. Starting at the highest point, we find a small ledge of rock (A) jutting up from the turf: the northern face of this, which dips N. 19° E. at 35°, is scored by deep grooves running E. 19° S.: this is the only case where markings are found on the *limestone*. Next we come to a boss of limestone (B), on the north-western face of which are chert-patches, such as have been just described, polished and marked by grooves running S. 30° E.

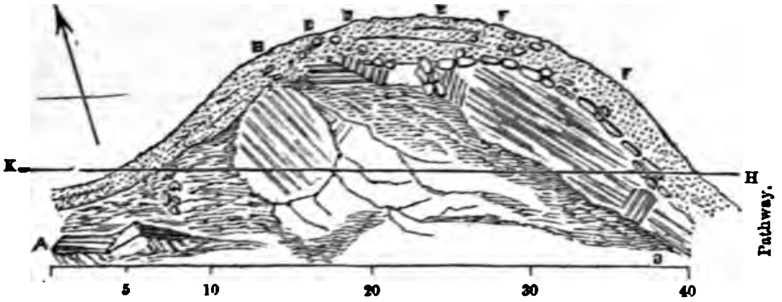

FIG. 1. GROUND-PLAN OF 'THE BLOODY STONE.'

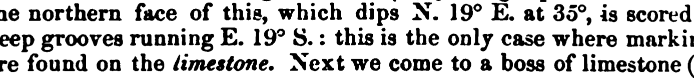

FIG. 2. SECTION ACROSS FIG. 1, FROM H. TO K.

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* These patches probably gave the name originally, and the fact, or legend, of a man having been thrown from his horse and killed here, was applied or invented to account for their presence.

At C are a few grooves on chert running E. 19° S. The chert-patches at D and E are the best marked of all, the grooves and scratches being very regular and distinct, in a direction N. 30° E. Fig. 3 is a sketch, half the natural size, of a bit of the rock broken off from E.: the side turned to the light is beautifully polished and grooved; the side in shadow gives a section at right angles to the polished face, and shows how the chert-nodule, which is marked by the darker shading, has been worn down and polished. Lastly, we have the largest polished face, FF, dipping E. 40° N. at 15°: the grooves and scratches run E. 40° S., and are crossed at G by a set of finer markings, running over a highly polished face of chert in a direction E. 40° N. In the section the dotted part is limestone, and some chert-nodules are introduced, which in the interior of the rock have their usual irregular shape, but on the surfaces B and F have had their upper faces planed down and scratched.

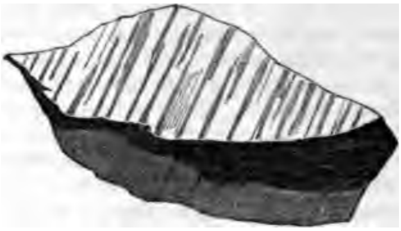

FIG. 3. FRAGMENT OF ROCK, GROOVED AND POLISHED BY ICE.

Now, it seems to me that these markings must be one of two things—either ice-scratches or 'slickenside.' If the latter, one would expect the markings to show some regularity in their direction, which they do not, for there are at least three distinct sets of scratches: nor can I conceive a fault or fracture running *through* chert-nodules, so as to slice them in two and then polish the faces against one another.

But the irregularity of direction, on the other hypothesis, may be easily explained by supposing different masses of ice at different times moving in different directions; and the planing down of the chert-nodules is just what we know ice will do. I may add, that among the heaps of stones gathered from the fields, and in the walls, a little higher up the hill, I found two ice-scratched bits of Mountain Limestone; two blocks of quartz rock, one angular, the other partly rounded, which were certainly foreigners; and many rounded lumps of two varieties of greenstone, one of which was most likely toadstone, but the other was unlike any toadstone I know of, and was, I strongly suspect, a stranger.

III. ON PREGLACIAL (?) DRIFT IN QUEEN'S COUNTY, IRELAND.

By G. HENRY KINAHAN, F.R.G.S.I.

'THE Coal-measure hills that form the outer margin of the Castlecomer table-land are generally covered with local drift; but the drift on nearly all the other Coal-measure hills is largely composed of limestone, even on the top of hills 700 feet high. What is most remarkable, however, is that in some places there are valleys and plains not more than 400 feet above the sea without a particle of limestone-drift on them, while hills in their vicinity are covered with it.'*

In sinking the various pits in the Queen's County Collieries, a *Stratified Drift* was found under some of this *Boulder-clay*. When the place was visited, none of these sections could be examined; but fortunately a record of each was kept in the 'bore-books' that are in the possession of the different agents and proprietors.

This paper will refer principally to the drift at the Newtown Colliery, as B. B. Edge, Esq., of Clonbrock House, has kindly given me valuable information and details of some of the sections there situated.

Near the west of this colliery, a pit was opened through 55·92 feet of drift, the details of which are copied from Mr. Ahern's 'bore-book,' now in the possession of Mr. Edge.

Section No. 1.

		Feet.
5. Clay with boulders of limestone	*Boulder Drift*	36·5
4. Sand and gravel	*Preglacial Drift*	6·25
3. Book- or leaf-clay, calcareous		3·17
2. Strong clay with detached pieces of coal		6·00
1. Fine sand		4·00
		55·92

In a pit due east of Newtown Cross-roads, three feet of peat ('which, although saturated with water, would blaze like a candle when placed in the fire') was found under the *Boulder-drift*. Mr. Edge gives the following as the approximate thickness of the beds passed through:—

Section No. 2.

		Feet.
8. Soil	*Reassorted Drift*	1
7. Yellow clay		3
6. Blue clay with limestone-boulders	*Boulder Drift*	60
5. Fine sand	*Preglacial Drift*	10
4. Gravel		9
3. Blue clay		4
2. PEAT		3
1. Whitish clay		6
		96

Five hundred yards north of Newtown Cross-roads, peat was also found: here it was under about 54 feet of drift. Of this place Mr. Edge says, 'Peat was found embedded in the shale which formed the roof of the coal. It was about 2·5 feet thick; but very little attention was given to it at the time. The coal in this place was 18 yards from the surface, and was a 'standing vein,' having been bent upwards by the great Newtown fault.'

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* See Explanation of Sheet 137 of the Map of the Geological Survey of Ireland, p. 50.

Of a pit at the edge of the Newtown coal, 'about three hundred yards from Lally's Bridge as you go up the stream,' Mr. Edge gives the following particulars:—

'SECTION NO. 3.

		Feet.
5. Soil	*Reassorted Drift*	1
4. Yellow clay		4
3. Blue clay withl imestone-boulders	*Boulder Drift*	81
2. Sand and gravel	*Preglacial Drift*	7
1. Fire-clay		3
		96

'In No. 1, large pieces of round timber, about 5 inches in diameter, seemingly birch or hazel, were embedded; also what seemed to me to be hazel-nuts.'

The *Boulder-drift* hereabouts is unmistakeable, containing numerous polished and well-scratched blocks of Limestone. The 'Book-' or 'Leaf-clay' mentioned in the first section, is clay that was deposited in fine laminæ.

From the foregoing sections, it will be seen that at the Newtown Colliery there was a drift *Preglacial* in relation to the overlying *Boulder-drift*; but whether it existed previous to all the *Boulder-drift* in its neighbourhood, it is impossible to say. Unfortunately, the men that opened these sections were only interested in the underlying coal, and therefore paid little attention to the drift; and as now all the coal at this place is worked out, there is no chance of new pits being opened; but that interesting results may yet be gleaned in that neighbourhood, seems likely from the following facts stated by Mr. Edge:—'About twelve or thirteen years since, a branching coral and shells of mollusca, something like the common cockle, were found 24 yards deep in the drift close upon the coal at the Newtown Colliery; and similar shells were got at the edge of the coal in the Geneva Colliery under 6 feet of drift.' The Geneva Colliery lies a little SW. of the Newtown Colliery.

NOTICES OF BRITISH AND FOREIGN MEMOIRS.

I. PROF. SUESS ON CEPHALOPODA OF THE GENUS ACANTHOTEUTHIS.

PROF. SUESS has prepared for publication a Memoir on the fossil Cephalopods belonging to the genus Acanthoteuthis (R. Wagner). A fine series of well-preserved specimens of the *Acanth. bisinuata* (Brown), obtained from the schists of Raibl in Carinthia, has enabled him to determine the true characters of the genus.

M. Suess has recognized on these specimens, the head with the mandible, the arms furnished throughout their length with a double row of hooks, the ink-bag, the dorsal shield and phragmacone, with the chambers, the ligatures, traces of the siphuncle, and here and there some remains of the mantle. The dorsal shield, hitherto unknown as to its form, presents two concave lobes behind the hyperbolar region. The *alveolus*, distinguished by the abnormal striæ of growth lately noticed by Prof. Huxley as probably belonging to a new type of Belemnites, is considered by Prof. Suess to belong to the genus *Acanthoteuthis.**—*L'Institut*, 5th July, 1865.—J. M.

II. Prof. Unger on the Fossil Plants of Hungary.

PROF. UNGER has presented to the Academy of Sciences of Vienna a Memoir on the Fossil Plants of Hungary and Transylvania, in which he treats specially of those found by M. Stur in the Upper Cretaceous Deposits of Déva, Transylvania. All the specimens are well preserved, so that they can be recognized with certainty as belonging to genera allied to those of the present day; a fact of much importance in the determination of the Dicotyledonous plants of the Cretaceous period.—*L'Institut*, 12th July, 1865.—J. M.

III. On the Group of Feldspars. By M. Tschermak.

THESE minerals, abundantly distributed in certain rocks of the globe, are interesting to the chemist, mineralogist, and geologist, and have been the subject of numerous memoirs. The continued chemical researches on these minerals have increased their complication—substances identical by their physical characters being often found chemically very different; some not assuming a definite character, others inconsistent with a systematic classification—more especially the feldspars, containing both soda and lime. According to the opinion more than once advanced, the feldspars could only be mixtures of isomorphous combinations. M. Tschermak considers that in reality all the feldspars are only mixtures of three substances, which exist in nearly a pure state in adularia, albite, and anorthite.

The potash-feldspars, comprised generally under the name of orthoclase, are regular mechanical combinations of orthoclase and albite, which, however, are not isomorphous, orthoclase crystallizing in the monoclinic and albite in the triclinic system. The constant combination of particles of albite gives rise to forms of dimensions similar to those of adularia; and thus the accession of the albite, although not isomorphous in itself, only modifies very slightly the form of orthoclase.

All the other feldspars are isomorphous mixtures of albite and anorthite, to which, in certain cases, orthoclase is added in small quantities.

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* See Geol. Mag., Feb. 1865, p. 67.

The minerals distinguished specifically under the names of labradorite, andesine, and oligoclase, are in reality only terms of a continuous series. Those to which we cannot assign a place in the system are only intermediate terms of this series, which, up to the present time, have not been studied in detail. Two rather rare minerals—namely, Hyalophane, which contains *barytes*, and Danburite, in which *boracic acid* has replaced the alumina—range themselves equally in the group of feldspars.

The isomorphous mixtures of orthoclase and albite, and that more complete of albite, anorthite, and danburite, as well as that between orthoclase and barytiferous feldspar, have the atomic constitution shown in the following table:—

CHEMICAL COMBINATIONS.	CHEMICAL FORMULÆ.	MIXTURES OF SIMPLE COMBINATIONS.
Anorthite	$Ca^2\ Al^2\ Al^2\ Si^4\ O^{16}$	Oligoclase, Andesine, Labradorite, &c.
Albite	$Na^2\ Al^2\ Si^2\ Si^4\ O^{16}$	
Adularia	$K^2\ Al^2\ Si^2\ Si^4\ O^{16}$	...Orthoclase, Sanidine, &c.
Feldspar (barytic)	$Ba^2\ Al^2\ Si^2\ Si^4\ O^{16}$	Hyalophane.
Danburite	$Ca^2\ B^2\ B^2\ Si^4\ O^{16}$	

Perhaps it would be convenient to admit for the feldspars of ordinary composition only three genera, that could be subdivided according to the proportions in which the normal species are found mixed in them.—*L'Institut, June* 1865.—J. M.

IV. ON CONSIDERABLE DEPOSITS OF PHOSPHATE OF LIME AT CACERES, ESTREMADURA. By M. R. DE LUNA.

THESE deposits are very extensive, and occur on the line of railway from Estremadura to Portugal. The means of transport are very costly in comparison to that of similar deposits. The phosphate of lime attains a maximum of 85 per cent. in the formation of Montanches, six leagues from Caceres and eight leagues from Logrosan, and the minimum is about 50 per cent. M. Luna has also noticed a deposit containing 72 per cent. of $\dot{C}a^3\overset{..}{\dddot{P}}$, extending over four square kilomètres, about half an hour's journey from Caceres.

The last mines discovered at Montanches are as rich as those of Logrosan. The phosphate is found in the cretaceous strata, and in great abundance in the silicious bed; it presents a fibrous texture, and as the formations do not contain carbonate of lime, it is more readily attacked by sulphuric acid.

Phosphate of Caceres.	Maximum.	Minimum.
Residue insoluble in nitric acid	47·02	21·05
Water	3·00	1·33
Tribasic phosphate of lime	72·10	50·10
Oxide of iron, &c. &c., and loss	3·85	1·55
Montanches.		
Tribasic phosphate	85·03	
Carbonate of lime	10·35	
Oxide of iron—silica	2·40	
Water	2·22	

Comptes Rendus.—J. M.

V. ON THE PHYSICAL HISTORY OF METEORITES.

By H. C. SORBY, F.R.S.

THOUGH I am most willing to admit that much remains to be learned before we can look upon the following theory as anything more than provisional, yet at all events it serves to unite a great number of facts, and is not opposed to any with which I am now acquainted. I shall describe the facts and discuss the objections to this and other theories in a communication to the Royal Society.

As shown in my paper in the 'Proceedings of the Royal Society,' (xiii. 333), there is good proof of the material of meteorites having been to some extent fused, and in the state of minute detached particles. I had also met with facts which seemed to show that some portions had condensed from a state of vapour; and I expected that it would be requisite to adopt a modified nebular hypothesis, but hesitated until I had obtained more satisfactory evidence. The character of the constituent particles of meteorites and their general microscopical structure differ so much from what is seen in terrestrial volcanic rocks, that it appears to me extremely improbable that they were ever portions of the moon, or of a planet, which differed from a large meteorite in having been the seat of a more or less modified volcanic action. A most careful study of their microscopical structure leads me to conclude that their constituents were originally at such a high temperature that they were in a state of vapour, like that in which many now occur in the atmosphere of the sun, as proved by the black lines in the solar spectrum. On cooling, this vapour condensed into a sort of cometary cloud, formed of small crystals and minute drops of melted stony matter, which afterwards became more or less devitrified and crystalline. This cloud was in a state of great commotion, and the particles moving with great velocity were often broken by collision. After collecting together to form larger masses, heat, generated by mutual impact, or that existing in other parts of space through which they moved, gave rise to a variable amount of metamorphism. In some few cases, when the whole mass was fused, all evidence of a previous history has been obliterated; and on solidification a structure has been produced quite similar to that of terrestrial volcanic rocks. Such metamorphosed or fused masses were sometimes more or less completely broken up by violent collision, and the fragments again collected together and solidified. Whilst these changes were taking place, various metallic compounds of iron were so introduced as to indicate that they still existed in free space in the shape of vapour, and condensed amongst the previously formed particles of the meteorites. At all events, the relative amount of the metallic constituents appears to have increased with the lapse of time, and they often crystallized under conditions differing entirely from those which occurred when mixed metallic and stony materials were metamorphosed, or solidified from a state of igneous fusion in such small masses that the force of gravitation was too weak to separate the constituents, although they differ so much in specific gravity.

(Report of Brit. Assoc. 1864.) Possibly, however, some meteoric irons have been produced in this manner by the occurrence of such a separation. The hydro-carbons with which some few meteorites are impregnated, may have condensed from a state of vapour at a relatively late period.

I therefore conclude provisionally that meteorites are records of the existence in planetary space of physical conditions more or less similar to those now confined to the immediate neighbourhood of the sun, at a period indefinitely more remote than that of the occurrence of any of the facts revealed to us by the study of Geology —at a period which might, in fact, be called *pre-terrestrial.*

BROOMFIELD, SHEFFIELD: *July* 1865.

VI. ON THE MICROSCOPICAL STRUCTURE OF MOUNT SORREL SYENITE, ARTIFICIALLY FUSED, AND COOLED SLOWLY. By H. C. SORBY, F.R.S., F.G.S., &c., of Sheffield. (Proceedings of the Geological and Polytechnic Society of the West Riding of Yorkshire, 1863–64, pp. 301–304.)

MR. SORBY thus describes the Syenite of Mount Sorrel:— 'The rock operated on is a mixture of reddish felspar, clear green hornblende, and quartz, along with some opaque minerals, evidently in a greatly altered state, perhaps originally pyrites or magnetic oxide of iron. The felspar is in very distinct crystals, but has often caught up much hornblende; and the quartz fills up the spaces between the other minerals, or is curiously crystallized along with the felspar, so as to form a microscopic "graphic granite," or "hebraic felspar;" and it is especially important to bear in mind, that the quartz contains very many *fluid-cavities*, nearly filled with water, as described in my paper in the Quart. Journ. of the Geological Society (vol. xiv. p. 453); and, in accordance with the principles therein explained, they indicate that the rock was consolidated under a very great pressure.' These *fluid-cavities*, he adds, 'show the spontaneous movements of the bubbles which they contain better than those I have seen in any other rock.'

Of this Mount Sorrel Syenite, Mr. J. G. Marshall, F.G.S., melted large quantities, allowing it to cool very slowly; and of this material Mr. Sorby examined microscopically thin slices, comparing its structure with that of various kinds of igneous rocks in their natural state, and after having been fused and slowly cooled. After detailing the characters observed in the artificial rock, Mr. Sorby remarks that, as the hornblende melted more easily than the quartz and felspar, and as a portion of the mineral rose upwards, the whole was not thoroughly incorporated. Nevertheless this circumstance is not, he says, enough to account for the difference between the original and the fused rock, as seen also in the experiments of M. Delesse; but 'an explanation must be sought for in the very different circumstances under which they were formed.'

The fused and cooled mass is quite unlike syenite or granite, but has a resemblance to some of the stony masses obtained by fusing basalt and basaltic lavas. 'The presence of water, an intense pressure, and a far more gradual cooling, all of which we are unable to imitate successfully, probably suffice to explain the total difference in the structure of the natural and the artificial products. At the same time,' adds Mr. Sorby, 'the making of such experiments, and the microscopical examination of the resulting masses, are likely to lead to a far better knowledge of igneous rocks than we at present possess.'—T. R. J.

REVIEWS.

I. MANUAL OF GEOLOGY. By the Rev. S. HAUGHTON, M.D., F.R.S., &c. London: LONGMANS, GREEN, and Co. 1865. 8vo., pp. 360.

IN 1862, Prof. Haughton had a reporter to take down a literal and verbatim report of a course of lectures on Geology, and these he now without alteration or emendation, publishes as a Manual of Geology. Has the science been standing still during that period? Was there nothing to add or to alter in 1865, to the prelections of 1862? But, granting that by some mysterious second-sight the Professor did foresee the recent discoveries—that he conjured up the strange spectre of the Archæopteryx, and clearly saw the Laurentian Eozoön, we scarcely think that the very words of a lecture to a class are likely to be the best for a manual for the student's private study. The hasty composition, the vague statements, and the rough-and-ready illustrations which necessarily belong to the extempore discourse, are too apparent in every page of this volume. And we cannot divine what the dissertation on the structure of honeycomb, with the history of the various opinions relative thereto from Pappus downwards to Haughton, has to do with an exposition of Geology. It would be unfair, however, to the learned author, were we not to add, that the student of Geology will find many things worth his careful attention in this volume. For instance, many will prize the volume because it contains a reprint of Prof. Haughton's translation of Durocher's important essay on Comparative Petrology. Our great regret, however, is, that Prof. Haughton, instead of producing a really valuable manual, in which he could have incorporated many of his original and useful observations and generalizations—a work that would be deserving a place alongside of the admirable volumes of Prof. Green on the Protozoa and Cœlenterata in the same series—has satisfied himself with sending to the press the reporter's version of his extempore lectures.

II. ICE-CAVES OF FRANCE AND SWITZERLAND. A NARRATIVE OF SUBTERRANEAN EXPLORATION. By the Rev. G. F. BROWNE, M.A. London: LONGMANS, GREEN, and Co. 1865. Pp. 315.

THE desire for novel adventure which urges the members of the Alpine Club up the sides of virgin mountains, has led Mr. Browne to acquaint himself with eternal ice in the dark recesses of natural Glacières, where more gains to science may be expected, and less danger to limb demanded. Very little was known about natural ice-caves, except that they did exist. The little that was known Mr. Browne made himself acquainted with, and then set out on his tour of examination of twelve glacières, the localities of which he had succeeded in discovering. The general reader will find his narrative full of interesting adventure, and lively description of the scenes through which he passed, as well as of the wonders he found in the caves. For the man of science they contain many interesting facts and puzzling phenomena which must yet rest some time before they can be thoroughly understood and expounded.

Ice-caves occur at depths varying from 50 to 200 feet below the surface of the earth, unconnected with glaciers or snow-mountains, and in latitudes and at altitudes where ice would not under ordinary circumstances be supposed to exist. They are employed, when the artificial stores of ice are exhausted, to supply this now almost necessary luxury. The ice is sometimes opaque, but frequently perfectly clear and transparent, and often formed into masses of the most beautiful or the most grotesque forms. We do not wonder that Mr. Browne, even with benumbed fingers and wet feet, crawling on all-fours on slippery ice, gets occasionally into raptures with the wondrous scene suddenly revealed to his view by the light of his torch.

The great difficulty with regard to these ice-caves or glacières, is to account for their existence. Our author, after recounting the numerous—many of them most absurd—theories which have been offered in explanation, gives one which to our mind is as unsatisfactory as any of the rest. It is, as he tells us, that of Deluce's, but arrived at by himself independently. He thus states it:—'The heavy cold air of winter sinks down into the glacierès, and the lighter warm air of summer cannot on ordinary principles of gravitation dislodge it, so that heat is very slowly spread in the caves; and even when some amount of heat does reach the ice, the latter melts but slowly, for ice absorbs 60° C. of heat in melting; and thus, when ice is once formed, it becomes a material guarantee for the permanence of ice in the cave.' We doubt if the air is so stable a body as this theory demands. Its power of conducting heat is also considerable. It is true that the air is always cold in the caves; but this is easily explained by the generally wet surface of the ice, which in melting absorbs so much heat. May not the earth rather than the air be the cause of the ice in the caves? There are different temperature-layers in the earth's crust, as they are affected by external heat. First, there is the thin surface-layer, affected by the varying temperature of day and night. Then there is the season-temperature plane, varying with the uniformity of the seasons and the conducting power of the materials of the crust, being at the Equator only a foot below the surface, in the Arctic regions from 3 to 12, while in the Temperate Zone it is 50 or 60 feet. Then there is the layer of climate temperature, where the summer's heat and the winter's cold are alike unfelt: in the Temperate Zone this varies from 200 to 400 feet, and in the Arctic regions from 8 or 10 to 90 Below this we have a plane of terrestrial temperature beyond the reach of external influences. It would be interesting to know the relation of the ice-caves to their different planes of temperature. If they occur in regions where the winter is long or very severe, and the summer short or very mild, and at such a distance from the surface that seasonal changes do not affect them, then it is quite easy to understand how ice would be found in them. It would be well if explorers would direct their attention a little to this matter.

The prismatic structure of the ice, so common in the glacières, is another interesting subject of enquiry. The Frenchman's suggestion at Bath, that it might be something akin to the rhomboidal form assumed by dried mud, we believe not to be far from the mark. But whether the desiccation results from heat or great cold, we cannot determine. We would associate with these other phenomena having, as we believe, a similar origin—as, for instance, the columnar structure in basalt, which has nothing whatever of a crystalline structure in it. It is curious to observe that basaltic prisms occur in exactly the same relation to the altered substance as do the prisms of ice—that is to say, in beds extending from the one surface to the other, and in cylindrical columns radiating from the centre to the circumference. The same cause produces the columns in wheaten starch. The walls of the vitrified forts in Scotland often exhibit beautiful specimens of the same structure in places where they have been subjected to great heat, though not sufficient to produce vitrification. We have also seen very beautiful and remarkably regular pentagonal and hexagonal columns produced in the brick floor of a baker's oven which had been long in use, and consequently subjected to frequent and considerable changes of temperature, though never sufficient to produce fusion. And we have often gathered good examples of hexagonal columns from the exposed bituminos shale-beds at Wardie, near Edinburgh.

III. ANALES DEL MUSEO PÚBLICO DE BUENOS AIRES, PARA DAR Á CONOCER LOS OBJETOS DE LA HISTORIA NATURAL NUEVOS Ó POCO CONOCIDOS CONSERVADOS EN ESTE ESTABLECIMENTO. Por GERMAN BURMEISTER, M.D., Ph.D. Buenos Aires, 1865. (4to., pp. 85, with six Plates.)

THE illustration, by Burmeister, of the cranial and of those dental characters of the *Macrauchenia patachonicha* not previously known, renders both interesting and instructive a retrospect of the steps by which a knowledge of this remarkable and anomalous extinct form of hoofed quadrupeds has been acquired.

In 1836, the fossils brought home by Darwin from South America, in H.M.S. Beagle, were submitted to Owen for determination and description. They were numerous, mostly fragmentary, and from among them were selected certain limb-bones and vertebræ, which were associated together as belonging to the same animal, and referred to a new genus and species, for which the name *Macrauchenia patachonicha* was proposed. Of the zoological position and affinities of this animal, Owen states—'In the Ungulate series there are but two known genera—the *Rhinoceros* and *Palæotherium*—which, like the quadruped in question, have only three toes on the hind-foot. Again, in referring the *Macrauchenia* to the tridactyle family of Pachyderms, we find towards the close of our analysis, and by a detailed comparison of individual bones, that the *Macrauchenia* has the closest affinity to the *Palæotherium*.'[*] But the degree of confluence of the radius with the ulna, and of the tibia with the fibula, indicated a closer resemblance than in *Palæotherium* to the ruminant state of those bones; and, guided by such indications, it seems that although certain fossil neck-vertebræ closely repeated, on a large scale, characters which Owen had discovered to be peculiar to the small South American *Camelidæ*, he did not hesitate to associate those fossil vertebræ with his new three-toed pachyderm. It is to be remembered that at this period (1837) the reform of the Cuvierian distribution of hoofed mammals had not been established; they were still either 'Pachyderms' or 'Ruminants.' In pointing out how the new three-toed Pachyderm showed alliance to the Ruminant, Owen recalls 'in how many particulars the *Camelidæ*, without losing the essential characters of *Ruminantia*, manifested a tendency to the Pachydermatous type, and the evidence which the lost genera *Macrauchenia* and *Anoplotherium* bear to a reciprocal transition from the Pachyderms to the Ruminants.[†]

The position and essential affinity of *Macrauchenia* are, however, definitely stated, and its remoter alliances as a three-toed Pachyderm are indicated. In 1840, Owen abandoned the Cuvierian classification of *Ungulata*, and in his 'Odontography' divides them (p. 523) into 'isodactyle,' 'anisodactyle,' and 'proboscidian' groups. He had found in the British Museum a fossil lower jaw with the molar series, from South America; and, firm in his convictions of the essential affinity of *Macrauchenia* to *Palæotherium*, he does not hesitate to refer the specimen to his new genus. In Plate 135, fig. 7, the teeth are figured as 'molars of the lower jaw of the *Macrauchenia patachonicha*.' ('Odontography,' 4to., Description of the Plates, p. 33.) In the description of this specimen—'§ 219, *Macrauchenia*,' comes between '*Palæotherium*' and '*Tapirus*' in the chapter 'Anisodactyle Pachyderms' (p. 572).

In 1846, Owen made known a new pattern of grinding surface of upper molar teeth, combining the main characters of that in *Rhinoceros* and *Palæotherium* with an unusual number of detached rings or islands of enamel. This pattern was exhibited by certain fossil teeth from South America, and on them was based the genus *Nesodon*. ('Reports of British Association,' 'Sections,' 1846, p. 66.) In 1847, in the 'Classification of *Ungulata*' (Quart. Journ. Geol. Soc., vol. iv.), Owen, substituting the more classical terms *Artiodactyla* and *Perissodactyla* for those used in the 'Odontography,' places *Macrauchenia* in the series *Perissodactyla*, with the following association: '*Tapirus*, *Macrauchenia*, *Nesodon*' (p. 139). In the Memoir on the latter genus ('Phil. Transactions,' 1853), its affinity to *Macrauchenia* is more fully elucidated, and it is remarked that

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[*] Zoology of the Voyage of the Beagle—Fossil Mammalia. 4to., p. 54.
Ibid., p. 55.

'the interval between *Toxodon* and *Macrauchenia* is partly filled by the newly-discovered *Nesodon* (p. 299). Seldom has the opinion of a Palæontologist on the zoological position of his subject been more definitely or more repeatedly enunciated than Prof. Owen's in reference to his *Macrauchenia.* The perversity with which some would exclude every statement save the 'indication of alliance to *Camelidæ* given by the cervical vertebræ,' is discreditable. Let anyone, for example, with the 'Quarterly Journal of the Geological Society,' vol. iv., 1848, open before him, at p. 139, read the following passage from the 'Zoologie' of Castelnau's 'Travels in South America:'—

'*Genre Macrauchenia.*—C'étaient des Pachydermes herbivores, des Ongulés perissodactyles; et malgré la ressemblance que la longueur de leur cou peut leur faire supposer avec les Chameaux et les Llamas, ils appartiennent bien au même ordre naturel que les Équidés, les Rhinocéridés, les Tapiridés, les Paléothéridés, et les Hyracidés.'

M. Paul Gervais, in penning the above, desired it to be supposed that *Macrauchenia* had previously been unnaturally introduced, like a 'supposititious' child, into the Artiodactyle group, along with the Camel-tribe, and that its position was rectified by the additional evidence which he was enabled to adduce from the fossils confided to him by Count Castelnau. Reference to the 'Zoologie' of Castelnau's Expedition, 'Anatomie,' 4to., p. 36, shows that these additions consist of the 'carpus,' with the 'lower articular surfaces of the radius and ulna.' The figures of the 'femur,' 'tibia,' and 'astragalus,' are copied from the 'Fossil Mammalia' of the Beagle. The evidence which had been given of the mandibular dentition he seems to be unacquainted with.

M. Gervais further writes—'Les vertèbres cervicales des Macrauchènes sont allongées, et rappellent celles des Llamas et des Chameaux; mais on doit remarquer qu'elles ont, comme celles des Rhinoceros et des Tapirs, les deux faces de leurs corps presque planes, et non fortement convexo-concaves, comme celles des Camélidés, ou mêmes des Chevaux.' (Tom. cit.) This excursion into comparative Osteology is not happy. The anterior convexity and posterior concavity of the articular surfaces of the bodies of the 3-7 cervical vertebræ and anterior dorsals of all Rhinoceroses and Tapirs is an elementary fact: the exceptional character of the almost flatness of those surfaces in *Auchenia* among Ruminants might pardonably be unknown to M. Gervais, nor does one look for any discussion of the minuter characters of arterial foramina, &c.

This, however, is quite clear—that Palæontology did not require to be told, after 1847, that Macrauchenia ought to be placed with *Tapirus*, *Palæotherium*, *Equus*, *Rhinoceros*, and *Hyrax*, among the Perissodactyle Ungulates.

What Palæontology did require may be stated to be: confirmation of the concurrence of Auchenian cervical vertebræ with Perissodactyle limb-characters; confirmation of the concurrence of mandibular dentition akin to that of *Palæotherium* and *Rhinoceros*, with those vertebræ and limb-bones; tests of the soundness of the indications of resemblance to *Nesodon* and to *Anoplotherium* which the known and acquired parts ascribed to *Macrauchenia* had suggested.

These requirements have been, at length, afforded by Burmeister's description and figures of an almost entire skeleton, including vertebræ and limb-bones, with the skull and dentition of a *Macrauchenia patachonicha*, which the late M. Bravard had obtained from the Pleistocene deposits of the Pampas of La Plata.

The auchenian cervicals are associated with a tritrochanterian femur, a palæotherian astragalus and tridactyle foot.

The lower molars, figured in pl. 135, fig. 7, of the 'Odontography,' are correctly ascribed to *Macrauchenia*, and, with figs. 5 and 6, pl. 7, of Burmeister's Memoir, show that the last molar differs from that of *Palæotherium*, and resembles that of *Rhinoceros*, in wanting the additional third lobe. But, perhaps, the most remarkable and unexpected confirmation of Owen's early surmise of secondary alliance, is the occurrence in the Perissodactyle series of the exceptional state of dentition which is shown by the *Anoplotherium* in the Artiodactyle series, viz., a continuous dental series concomitant with equality of length of the crowns of the teeth, the canines not being developed, as such, but resembling in proportions those of the Anoplothere. H. Burmeister remarks, there is also a general resemblance in the skull to that of the Anoplotherium (pp. 32, 33); but the orbit is quite circumscribed by bone, as in *Equus*, while the nostrils are placed high up on the head, encroaching between the orbits, as in *Toxodon*. In reference to the alleged affinity of *Macrauchenia* to *Nesodon*, we now have the evidence of the grinding surface of the upper molars; in which, although the crowns are shorter and transversely broader in *Macrauchenia*, they show, when worn down, three or four islands of enamel upon the inner half of the grinding surface.

IV. THE DUBLIN QUARTERLY JOURNAL OF SCIENCE, No. 18. April 1865.

THIS contains, besides some interesting Botanical, Antiquarian, and Agricultural papers,—(1.) The Rev. M. H. Close's account of the general glaciation (by glacier-ice) of the rocks in the neighbourhood of Dublin (as shown by the map), the great glacial stream having invaded the area of the local ice-system of the Dublin and Wicklow Mountains, which, moreover, have modified its direction, though at one time they seem to have been wholly subjected to the transverse passage of the great glacier, and have had gaps or passes, such as the Scalp, cut out across their ridges by its agency. (2.) Mr. J. B. Doyle's note on the occurrence of a *Knorria* in the Lower Carboniferous Limestone Series of Kildare. (3.) Mr. H. B. S. Montgomery's short but clear account of a new locality of granite blocks in the Carboniferous Limestone near Rathfarnham. (4.) Mr. A. Macalister's notice of a remarkable specimen of *Ulodendron*, found at Hurlet, Renfrewshire, which has suggested to him, firstly, that most probably *Ulodendron* ranks nearer to the *Cycadaceæ* than to any other order; and that, 'had we a Cycadaceous plant whose leaf-scars were large and circular, and whose scales were as numerous and small as those of a Lycopod, we could realise all the conditions of *Ulodendron*;' and, secondly, that *U. majus* and *U. minus* are probably identical. (5.) Mr. F. J. Foot's interesting account of a boulder of Limestone in the Shannon, shifted some fifty yards by the ice in the cold and stormy winter of 1855, in near proximity to another ice-carried boulder belonging to the Glacial Period, and consisting of jasper, the parent rock of which is recognized six miles off.

V. THE 'FLINT IMPLEMENTS' FROM DRIFT, NOT AUTHENTIC. BEING A REPLY TO THE GEOLOGICAL EVIDENCES OF THE ANTIQUITY OF MAN. By NICHOLAS WHITLEY, &c. 8vo., pp. 59. LONGMANS & Co., London; and NETHERTON, Truro. 1865.

IS it of use to draw attention to obstinately one-sided views of facts, and to dogmatic negations of what experts have seen reason to believe? If it be, the good can only consist in informing the persistent jibber that other people are going forward, and leaving his point of view behind,—in telling those not yet acquainted with the matter, that wider experience, better knowledge of natural objects, and more matured conclusions than those offered by the partial dogmatist, have been submitted to the public,—and in reminding ourselves that patience is required in teaching those who come to be taught, and extreme patience in arguing with those who teach themselves,—and that the lingering stragglers in the march of science, who will bandy old arguments and waste their time with false notions, must not do more mischief, if it can be helped, than lose their own place in the ranks.

We are not, at present, sufficiently interested in the matter to go over all the subject of Flint Implements,—how nature breaks flints, how man breaks them, and has broken them, and has used both the natural and the artificial fragments for tools and weapons of many kinds;—much less will we here offer a dissertation on the flints variously chipped into chisels, hammers, adzes, wedges, &c.,—whether archaic or historic: the English reader has Prestwich, Evans, Lyell, Lubbock, and others, to teach him, if he does not know already. Mr. Whitley offers nothing but doubts, which have already had full consideration from those who really know how flint behaves under frost and under blows, and who know what early men, such as the cave-dwellers of Dordogne, really did with flint, in what forms they chipped it, what they used, and what they wasted. Mr. Whitley says that, as a land-surveyor, he has seen much to teach him geology, and to enable him to venture on a controversy about Flint Implements: he observes, too, that William Smith, the father of English Geology, and Bernard Palissy, a pioneer of Geology in France, were also land-surveyors. So we hope to have better results of his experience by-and-by,—maybe to equal theirs;—but in the meantime, re-quoting from his essay 'the notable saying of Locke,' we have, in this would-be 'Reply,' another instance that 'men see a little, presume a great deal, and so jump to the conclusion.'

REPORTS AND PROCEEDINGS.

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British Association for the Advancement of Science, Birmingham, September 6th, 1865.

In his Inaugural Address, the President of the British Association (Professor J. Phillips) thus speaks of Geology, and of its relations to the History of Man: –

The greater our progress in the study of the economy of Nature, the more she unveils herself as one vast whole,—one comprehensive plan,—one universal rule, in a yet unexhausted series of individual peculiarities. Such is the aspect of this moving, working, living system of force and law: such it has ever been, if we rightly interpret the history of our own portion of this rich inheritance of mind, the history of that Earth from which we spring, with which so many of our thoughts are co-ordinated, and to which all but our thoughts and hopes will again return.

How should we prize this history! and exult in the thought that in our own days, within our own memories, the very foundations of the Series of Strata, deposited in the beginning of time, have been explored by our living friends, our Murchison and Sedgwick, while the higher and more complicated parts of the structure have been minutely examined by our Lyell, Forbes, and Prestwich!* How instructive the history of that long series of inhabitants which received in primeval times the gift of life, and filled the land, sea, and air with rejoicing myriads, through innumerable revolutions of the planet, before in the fulness of time it pleased the Giver of all good to place man upon the Earth, and bid him look up to Heaven!

Wave succeeding wave, the forms of ancient life sweep across the ever-changing surface of the earth; revealing to us the height of the land, the depth of the sea, the quality of the air, the course of the rivers, the extent of the forest, the system of life and death,—yes, the growth, decay, and death of individuals, the beginning and ending of races, of many successive races of plants and animals, in seas now dried, on sandbanks now raised into mountains, on continents now sunk beneath the waters.

Had that series a beginning? Was the earth ever uninhabited, after it became a globe turning on its axis and revolving round the sun? Was there ever a period since land and sea were separated—a period which we can trace—when the land was not shaded by plants, the ocean not alive with animals? The answer, as it comes to us from the latest observation, declares that in the lowest deposits of the most ancient seas in the stratified crust of the globe, the monuments of life remain. They extend to the earliest sediments of water, now in part so changed as to appear like the products of fire. What life? Only the simpler and less specially organized fabrics have as yet rewarded research among these old Laurentian rocks,—only the aggregated structures of Foraminifera have been found in what, for the present at least, must be accepted as the first deposits of the oldest sea. The most ancient of all known fossils, the ***Eozoön Canadense*** of Sir W. Logan, is of this low, we may even say lowest, type of animal organization.

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* The investigations of Murchison and Sedgwick in the Cambrian and Silurian Strata began in 1831; the views of Sir C. Lyell on Tertiary periods were made known in 1829.

Then step by step we are guided through the old Cambrian and Silurian systems, rich in Trilobites and Brachiopoda, the delights of Salter and Davidson: with Agassiz and Miller and Egerton we read the history of the strange old Fishes of the Devonian rocks; Brongniart, and Göppert, and Dawson, and Binney, and Hooker unveil the mystery of the mighty forests now converted to coal; Mantell and Owen and Huxley restore for us the giant Reptiles of the Lias, the Oolite, and the Wealden; Edwards and Wright almost revive the beauteous Corals and Echinodermata; which with all the preceding tribes have come and gone before the dawn of the later periods, when fragments of Mammoths and Hippopotami were buried in caves and river-sediments to reward the researches of Cuvier and Buckland, Prestwich and Christy, Lartet and Falconer.

And what is the latest term in this long series of successive existence? Surely the monuments of ever-advancing art—the temples whose origin is in caverns of the rocks; the cities which have taken the place of holes in the ground, or heaps of stones and timber in a lake; the ships which have outgrown the canoe, as *that* was modelled from the floating trunk of a tree, are sufficient proof of the late arrival of man upon the Earth, after it had undergone many changes, and had become adapted to his physical, intellectual, and moral nature.

Compared with the periods which elapsed in the accomplishment of these changes, how short is the date of those yet standing monoliths, cromlechs, and circles of unhewn stone, which are the oldest of human structures raised in Western Europe, or of those more regular fabrics which attest the early importance of the monarchs and people of Egypt, Assyria, and some parts of America! Yet tried by monuments of natural events which happened within the age of man, the human family is old enough in Western Europe to have been sheltered by caverns in the rocks, while herds of reindeer roamed in Southern France,* and bears and hyænas were denizens of the South of England.† More than this, remains of the rudest human art ever seen are certainly found buried with and are thought to belong to races who lived contemporaneously with the mammoth and rhinoceros, and experienced the cold of a Gallic or British winter, from which the woolly covering of the wild animals was a fitting protection.

Our own annals begin with the Kelts, if indeed we are entitled to call by that historic name the really separate nations, Belgian,

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* See the Memoirs of M. Lartet on the Caves of the Dordogne, 1863-4.

† In the caves of Gower, Devon, and Somerset, flint flakes occur with several extinct animals.

Iberian, and Teutonic, whom the Roman writers recognize as settlers in Britain;* settlers among a really earlier family, our rudest and oldest forefathers, who may have been, as they thought themselves to be, the primitive people of the land.† But beyond the Κελταί who occupied the sources of the Danube and the slopes of the Pyrenees, and were known to Rome in later days, there was present to the mind of the father of Grecian history a still more western race, the Cynetæ, who may perhaps be supposed the very earliest people of the extreme west of the continent of Europe. Were those the people, the first poor pilgrims from the East, whose footsteps we are slowly tracing in the valleys of Picardy and the south of England, if not on the borders of the lakes of Switzerland? Are their kindred still to be found among the Rhætic Alps and the Asturian cliffs, if not amid the wilds of Connemara, pressed into those mountainous recesses by the legions of Rome, the spear of the Visigoth, and the sword of the Saxon? Or must we regard them as races of an earlier type, who had ceased to chip flints before the arrival of Saxon, or Goth, or Kelt, or Cynetian? These questions of romantic interest in the study of the distribution and languages of the families of man are part of a large circle of inquiry which finds sympathy in several of our sections, especially those devoted to Zoology, Physiology, and Ethnology. Let us not expect or desire for them a very quick, or, at present, a very definite settlement. Deep shadows have gathered over all the earlier ages of mankind, which perhaps still longer periods of time may not avail to remove. Yet let us not undervalue the progress of ethnological inquiry, nor fail to mark how, within the period to which our recollections cling, the revelations of early Egypt have been followed by a Chronology of the ancient kingdoms on the Tigris and Euphrates, through the same rigorous study of language. Thus has our Rawlinson added another page to the brilliant discoveries of Young and Champollion, Lepsius and Rosellini.

Nor, though obtained in a different way, must we forget the new knowledge of a people nearer home, which the philosophic mind of Keller has opened to us among his native mountains. There, on the borders of the Alpine lakes, before the great Roman general crossed the Rhone, lived a people older than the Helvetians; whose rude lives, passed in hunting and fishing, were nevertheless marked by some of the many inventions which everywhere, even in the most unfavourable situations, accompany the least civilized of mankind. Implements of stone and pottery of the rudest sort belong to the earliest of these people; while ornamented iron weapons of war, and innumerable other fabrics in that metal, appear about the later habitations, and correspond probably to the period of the true Helvetii, who quitted their home and contended with Cæsar for richer settlements in Gaul. The people of whom these are the traces on almost every lake in Switzerland are recognized as well in the ancient lake-basins of Lombardy and among the Tyrolean Alps, and farther on the north side of the mountains; and probably fresh discoveries may connect them with the country of the Sarmatians and the Scythians.

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* Gallic or Belgian on the south-east coast; Iberian in South Wales; German at the foot of the Grampians.—(Tacitus, Vita Agricolæ.)

† 'Britanniæ pars interior ab iis incolitur, quos natos in insula ipsa memoria proditum dicunt.'—(Cæsar, v. 12.)

Thus at length is fairly opened, for archæology and palæontology to read, a new chapter of the world's history, which begins in the pleistocene periods of geology, and reaches to the prehistoric ages of man. Did our ancestors really contend, as the poets fancied,* with stones and clubs against the lion and the rhinoceros, and thus expel them from their native haunts, or have they been removed by change of climate or local physical conditions? Was the existence of the hyæna and the elephant only possible in Western Europe while a climate prevailed there such as now belongs to Africa or India? and was this period of high temperature reduced in a later time for the elk, reindeer, and musk-ox, which undoubtedly roamed over the hills of England and France? If we think so, what a vista of long duration stretches before us! for no such changes of climate can be supposed to have occurred except as the effect of great physical changes, requiring a lapse of many thousands of years. And though we may think such changes of climate not proved, and probably careful weighing of evidence may justify our disbelief, still, if the valleys in Picardy have been excavated since the deposit of the gravel of St. Acheul,†—and the whole face of the country has been altered about the caverns of Torquay since they received remains of animals and traces of man,‡—how can we admit these facts and yet refuse the time required for their accomplishment? First, let us be sure of the facts, and especially of that main fact upon which all the argument involving immensity of time really turns, viz. the contemporaneous existence of man with the mammoth of the plains and the bear of the caverns. The remains of men are certainly *buried* with those of extinct quadrupeds; but did they *live* in the same days, or do we see relics of different periods gathered into one locality by natural processes of a later date, or confused by the operations of men?

Before replying finally to these questions, further researches of an exact kind are desirable, and the Association has given its aid towards them, both in respect to the old cavern of Kent's Hole, and the newly opened fissure of Gibraltar, from which we expect great results, though the best of our labourers has ceased from his honourable toil.§ When these and many other researches are completed, some future Lyell, if not our own great geologist, may add some fresh chapters to the 'Antiquity of Man.'

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* Lucretius, v. 964–1283.

† Prestwich, Transactions of the Royal Society, 1860, and Proc. of Roy. Inst., Feb. 1864.

‡ Pengelly, Reports of the British Association, 1864.

§ The late Dr. Hugh Falconer, whose knowledge of the fossil animals of caves was remarkably exact, took a great share in these examinations.

In judging of this antiquity, in counting the centuries which may have elapsed, since smoothed flints fitted with handles of wood were used as chisels and axes by the earliest people of Scandinavia or Helvetia, and flakes of flint were employed to cleanse the skins of the reindeer in the caves of the Dordogne, or stronger tools broke up the ice in the valley of the Somme, we must be careful not to take what is the mark of low civilization for the indication of very remote time. In every country, among every race of men, such rude weapons and tools are used now, or were used formerly.. On the banks of the Ohio, no less than on the English hills, mounds of earth, rude pottery, and stone weapons occur in abundance; and indicate similar wants, contrivances, customs, ideas, in different races of men living in different periods. Even when in the same country, as in Switzerland, or England, or Denmark, successive deposits of instruments of stone, bronze, or iron,—successive burials of pines, beeches, and oaks,—successively extinguished races of elephants, elks, and reindeer, give us a real scale of elapsed time, it is one of which the divisions are not yet valued in years or centuries of years.

Toward a right judgment of the length of this scale of human occupation, two other lines of evidence may be thought worthy of notice; one founded on the anatomical study of the remains of early men, the other on the laws of language. If the varieties of physical structure in man, and the deviations of language from an original type, be natural effects of time and circumstance, the length of time may be in some degree estimated by the amount of the diversities which are observed to have happened, compared with the variation which is now known to be happening. This process becomes imaginary, unless we assume all mankind to have had one local centre, and one original language. Its results must be erroneous, unless we take fully into account the superior fixity of languages which are represented in writing, and the greater tendency to diversity of every kind which must have prevailed in early times, when geographical impediments were aggravated by dissocial habits of life. It appears, however, certain, that some differences of language, organization, and habits have separated men of apparently unlike races during periods longer than those which rest on historical facts.*

Ever since the days of Aristotle, the analogy existing among all parts of the animal kingdom, and in a general sense we may say among all the forms of life, has become more and more the subject of special study. Related as all living beings are to the element in which they move and breathe, to the mechanical energies of nature which they employ or resist, and to the molecular forces which penetrate and transform them, some general conformity of structure, some frequently recurring resemblance of function, must be present, and cannot be overlooked. In the several classes this analogy grows stronger, and in the subdivisions of these classes real family affinity is recognised. In the smallest divisions which have this family-relation in the highest degree, there seems to be a line which circumscribes each group, within which variations occur, from food, exercise, climate, and transmitted peculiarities. Often one specific group approaches another, or several others, and a question arises whether, though now distinct, or rather distinguishable, they always have been so from their beginning, or will be always so until their disappearance.

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* Max Müller on the Science of Language.

Whether what we call species are so many original creations or derivations from a few types or one type, is discussed at length in the elegant treatise of Darwin,* himself a naturalist of eminent rank. It had been often discussed before. Nor will anyone think lightly of such inquiries, who remembers the essay of Linnæus, 'De Telluris orbis incremento,' or the investigations of Brown, Prichard, Forbes, Agassiz, and Hooker, regarding the local origin of different species, genera, and families of plants and animals, both on the land and in the sea. Still less will he be disposed to undervalue its importance, when he reflects on the many successive races of living forms more or less resembling our existing quadrupeds, reptiles, fishes, and mollusca, which appear to have occupied definite and different parts of the depths of ancient time; as now the tiger and the jaguar, the cayman, and the gavial, live on different parts of the terrestrial surface. Is the living elephant of Ceylon the lineal descendant of that mammoth which roamed over Siberia and Europe, and North America; or of one of those sub-Himalayan tribes which Dr. Falconer has made known; or was it a species dwelling only in circumpolar regions? Can our domestic cattle, horses and dogs, our beasts of chase and our beasts of prey, be traced back to their source in older types, contemporaries of the urus, megaceros, and hyæna on the plains of Europe? If so, what range of variation in structure does it indicate? If not so, by what characters are the living races separated from those of earlier date?

Specific questions of this kind must be answered, before the general proposition, that the forms of life are indefinitely variable with time and circumstance, can be even examined by the light of adequate evidence. That such evidence will be gathered and rightly interpreted, I for one neither doubt nor fear; nor will any be too hasty in adopting extreme opinions, or too fearful of the final result, who remember how often that which is true has been found very different from that which was plausible, and how often out of the nettles of danger we have plucked the flowers of safety. At the present moment the three propositions which were ever present to the mind of Edward Forbes may be successfully maintained, as agreeing with many observed phænomena; and around them as a basis of classification may be gathered most of the facts and most of the speculations which relate to the history of life.† First, it may be admitted that plants and animals form many natural groups, the members of which have several common characters, and are parted from other groups by a real boundary-line, or rather unoccupied space. Next, that each of these groups has a limited distribution in space, often restrained by high mountains or deep seas, or parallels of temperature, within which it has been brought into being. Thirdly, that each group has been submitted to, or is now undergoing, the pressure of a general law, by which its duration is limited in geological time; the same group never reappearing after being removed from the series.

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* On the Origin of Species, 1859.

† See the remarkable Essay of E. Forbes on the distribution of the existing Fauna and Flora of the British Isles, in Memoirs of Geol. Survey of Britain, vol. i. p. 336.

SECTION C.—GEOLOGY.

SIR RODERICK MURCHISON, in his *Address to the Geological Section of the British Association* at Birmingham, after some congratulatory remarks, alluded to the addition made by Sir W. Logan, in the discovery of *Eozoön Canadense*, to our knowledge of the oldest stratified rocks, which both in Canada and Scotland are seen to be the lowest by position; and, remarking by the way that, whether *Eozoön* be present or not in the serpentinous marble of Connemara, that rock is of Lower Silurian age, and not older, he dwelt on the fact of a low Foraminifer (*Eozoön*) being the oldest known organism, succeeded in overlying formations by higher and higher animals; Fishes appearing in the Upper Silurian beds, higher vertebrates still later, and Man last of all in the youngest of Tertiary deposits. After some well-deserved compliments to the Foreign Geologists present on the occasion, the speaker said—'Among the recent important additions to our knowledge of the geographical distribution and characters of the Silurian rocks, I cannot but advert to the successful labours of Professor Harkness. He had already shown in the clearest manner, by the evidence of fossils and order of succession, that the lowest of the strata in the Cumbrian district of the Lakes, the slates of Skiddaw, are truly of Lower Silurian age, and not older than the Llandeilo group. Recently, in pursuing his labours, he has detected fossils in the "green slates" or volcanic ashes and porphyries which lie intermediate between the Skiddaw strata and the higher Silurian; and he has further found others in the Coniston Flags, which he views as equivalents of the upper part of the Caradoc formation. Further, Professor Harkness has shown, for the first time, that the slaty rocks of Westmoreland, which separate the Carboniferous limestone from the Permian of the Vale of the Eden, contain Lower Silurian fossils similar to those of Cumberland. I hope also to learn from him at this meeting what has been the effect of certain great faults ranging from north to south, which have impressed a grand and picturesque outline on that region, and upon the lines of which are situated the most striking of the lakes of the north-west of England.'

Sir RODERICK MURCHISON then alluded to the good results expected from the researches of the Dudley and Midland Geological Society on the rocks and fossils of the Lickey, Dudley, &c., and on the eruptive rocks of the Rowley Hills; and he reminded his hearers that Professor Jukes would, in an Evening Lecture, indicate the extent to which profitable sinkings for coal can be made through the red sandstones of the central counties. One such successful sinking was made by the late Earl of Dartmouth, only four miles to the west of Birmingham, twenty-seven years ago, and was then referred to by Sir Roderick as a good sign of the progressive influence of geological knowledge. Alluding to the probable increase of coal-area to be realized by following the South Staffordshire coal-field underground to the east, the speaker noticed the enormous annual increase in our use of coal (now amounting 'to the astounding figure of 93 millions of tons') as a caution against too sanguine expectations as to the duration of our coal supply. He then directed attention to the interesting accumulation of granitic and other drift of the Glacial Period to be studied near Wolverhampton, and said—'Coming hither in ignorance of what the several associations of local geologists (which rival each other in their researches) have accomplished, I shall be happy to learn that some of them have detected, in this portion of the kingdom, any of those proofs of the existence of man at an early period, when large animals, now extinct, prevailed in our islands, in ages so remote that, since then, the physical configuration of the country has undergone great changes. This inference is, as I have said, founded upon irrefragable evidence collected in different parts of Europe, as well as in our own country. When, however, we come to consider the *modus operandi* by which these great physical changes have been brought about, geologists have different opinions. As one who holds to the belief that in former periods the crust of the earth was from time to time affected by an agency much more powerful than anything which has been experienced in the historic era, I do not believe that the wear and tear due to atmospheric subaërial erosive agency could, even after operating for countless ages, have originated and deepened any of the valleys and gorges which occur in countries as flat as the tract in which we are now assembled.

'But, whilst I adhere to my long-cherished opinion as to the great intensity of power employed in the production of dislocations of the crust of the earth, and though I cannot subscribe to the doctrine that the ordinary action of deep seas remote from coasts can adequately explain the denudation of the old surface, even by invoking any amount of time, I recognize with pleasure the ability displayed by my able associates, Ramsay, Jukes, and Geikie,* in sustaining views which are to a great extent opposed to my own in this department of Theoretical Geology.

'Admiring the Huttonian theory, as derived from reasoning upon my native mountainous country Scotland, and fully admitting that on adequate inclines ice and water must, during long periods, have produced great denudation of the rocks, I maintain that such reasoning is quite inadequate to explain the manifest proofs of convulsive agency which abound all over the crust of the earth, and even are to be seen in many of the mines in the very tract in which we are assembled. Thus, to bring such things to the mind's eye of persons who are acquainted with this neighbourhood, I do not apprehend that those who have examined the tract of Coalbrook Dale will contend that the deep gorge in which the Severn there flows has been eaten out by the agency of that river, the more so when the deep fissure is at once accounted for when we see the abrupt severance that has taken place between the rocks which occupy its opposite sides. In that part of Shropshire, the Severn has not worn away the rocks during the historic era, nor has it produced a deeper channel; whilst in its lower parts it has only deposited silt and mud, and increased the extent of land on its banks.

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* The work of Geikie, recently published, and entitled 'The Scenery of Scotland viewed in connexion with its Physical Geology,' is an admirable illustration of that author's descriptive powers. Though I am opposed to his view of the original formation of valleys and deep depressions by rivers and the atmosphere, I quite agree with him as to the great effect produced by glaciers when that mountainous region was covered by snow and ice.

'Then, if we turn to the district in which we were last assembled, the valley at Bath is known to be the seat of one of those disturbances to which my eminent friend Sir Charles Lyell candidly applied the term "convulsion"; the hot waters of that city having ever since flowed out of a deep-seated fissure, clearly marked by the strata on the one side of the valley having been upheaved to a height very different from that which they once occupied in connection with those of the other side. When, indeed, we look to the lazy-flowing, mud-collecting Avon, which at Bath passes along that line of valley, how clearly do we see that it never scooped out its channel! Still more, when we follow it to Bristol, and observe it passing through the deep gorge of Mountain-limestone at Clifton, every one must then be convinced that it never could have produced such an excavation. In fact, we know that, from the earliest periods of history, it has only accumulated mud, and has never worn away any portion of hard rock.

'From such data I conclude that we cannot apply to flat regions, in which water has no abrading power, the same influence which it exerts in mountainous countries; whilst we are also compelled to admit that the convulsive dislocations of former periods produced many of those gorges in which our present streams flow. To pass, indeed, from the environs of Bath and Bristol, and even from the less distant Coalbrook Dale, you have only to contemplate the tract which lies between Birmingham and Dudley, and endeavour to satisfy the mind as to the processes by which it has been planed down before the surface was covered by the Northern Drift; for the great dislocations which this tract has undergone, as proved by many subterraneous workings, must have left a highly irregular surface, which was so levelled by some very active causes as to obliterate the superficial irregularities corresponding with the interior disturbances. In short, what was this great power of denudation which took place in a tract where there are no mountains whence powerful streams descended, and in which there are no traces of fluviatile action? Must we not, in candour, admit that such denudation is as difficult to account for, as it is to explain by what possible gradual agency the vast interior of the valley of elevation of the Weald of Sussex and Kent, and that of the smaller valley of Woolhope in Herefordshire, have been so absolutely and entirely denuded of every fragment of the enormous masses of débris which must have encumbered these cavities, as derived from the rocks which once covered them? Placing no stint whatever on the time which geologists must invoke to satisfy their minds as to the countless ages which elapsed during the accumulations of sediment, I reject as an assumption which is at variance with the numberless proofs of intense disturbance, that the mechanical disruptions of former periods, and the overthrow of entire formations, as seen in the Alps and many mountain-chains, can be accounted for by any length of action of existing causes.

'But I must not wander farther on, illustrating this principle, to which, as an old practical geologist, I still adhere, namely, that in former periods there existed forces which, though similar in kind, were of much greater intensity than those which now prevail, and without which we in vain seek to account for the upheavals, depressions, dislocations, and even many of the denudations of which the old crusts of the earth exhibit such undeniable proofs.'

In conclusion, Sir RODERICK spoke warmly of the labours of the Natural History Clubs; namely, the Malvern Club, with special mention of Dr. Holl's elucidation of the structure of the Malvern Range; the Caradoc, the Oswestry, the Woolhope, the Cotteswold, and other Clubs; all doing good Geological work, within easy reach of Birmingham, where certainly *the British Association*, with Phillips as President, and Lyell as ex-President, has delighted to honour Sir Roderick's favourite Science.

The following Papers were read before the GEOLOGICAL SECTION of the BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, at Birmingham, from Sept. 7 to 13, 1865:—

The President's (Sir Roderick I. Murchison) Opening Address. See above, p. 462, &c.

Rev. W. S. Symonds.—On some Ancient Drifts and Old River-beds of Siluria.

W. Pengelly.—The Insulation of St. Michael's Mount in Cornwall.

Rev. W. Purton.—The Geology of Coalbrook Dale.

G. Maw.—On the Extensive Deposits of White Clays and Sands in North Wales, antecedent to the Boulder-clay Drift. (See GEOLOGICAL MAGAZINE, May 1865, p. 200.)

C. J. Woodward.—On a Deposit near Lilleshall, Salop, containing Recent Marine Shells.

H. Chance.—On the Smelting of Rowley Rag.

Professor Harkness and H. Nicholson.—Additional Observations on the Geology of the Lake Country.

Henry Woodward.—Description of a New Chart of Fossil Crustacea.

W. M. Williams.—Some Vegetable Deposits in the Achensee, North Tyrol.

Geheimrath Von-Dechen and Professor F. Römer.—On the large Prussian Geological Map of the Rhenish Provinces and Westphalia.

W. Pengelly.—First Report of the Committee for the Exploration of Kent's Cavern.

Professor Harkness.—On the Metamorphic Rocks and Serpentine Marbles of Connemara and Joyce's County.

Professor Tennant.—On the Agates found in England, with specimens from different countries.

S. Bailey.—The Economic Value of the various Measures of Coal and Ironstone in the South Staffordshire Coal-field.

H. Johnson.—The Extent and Duration of the South Staffordshire Coal-field.

W. M. Williams.—The Ancient Glaciers of the North and East of Llangollen, and more particularly in the neighbourhood of the Hope Mountain.

Principal Dawson.—The Successive Palæozoic Floras in Eastern North America.

C. Moore.—On the Presence of a Greenstone Dyke in the Mendip Hills.

Rev. H. Housman.—Fossil Footprints in the New Red Sandstone at Brewood, near Wolverhampton.

R. A. Peacock.—On extensive and deep Sinkings of Lands in the Channel Islands' Seas, and on some Changes of the French Coast off the Bay of Biscay within the Historical period.

R. A. Peacock.—On Steam as the active Agent in Earthquakes.

D. Mackintosh.—The relative Extent of Atmospheric and Oceanic Denudation, with a particular reference to certain rocks and valleys in Yorkshire and Derbyshire.

Rev. A. M. M'Kay.—The Red Sandstone of Nova Scotia.

J. E. Taylor.—On Contortions in the Chalk at Whitlingham, near Norwich. (See GEOLOGICAL MAGAZINE, July 1865, p. 324.)

J. W. Salter.—Explanation of a Map of the Faults in the Gold District of Dolgelly.

T. A. Readwin.—On the recent Discovery of Gold at Gwynfynydd, North Wales.

H. Hicks and J. W. Salter.—Report on Further Researches in the Lingula Flags of South Wales.

D. Forbes.—First Report on the Igneous Rocks of Staffordshire.

W. Molyneux.—Further Report on the Distribution of the Organic Remains of the North Staffordshire Coal-field.

C. Twamley.—On the Faults in the South Staffordshire Coal-field, and their relation to the Igneous Rocks of the District.

W. Ness.—On the Coal-measures in Mold Valley, and their Products.

Rev. P. B. Brodie.—On the Fossiliferous Beds of the New Red Sandstone (Upper and Lower Keuper) in Warwickshire.

Professor Harkness and H. Nicholson.—On the Silurian Rocks of the Isle of Man.

H. Woodward.—Description of a new Phyllopodous Crustacean from the Moffat Shales, Dumfriesshire.

H. Woodward.—On the oldest known Brachyurous Crustacean (*Protocarcinus longipes*) from the Forest Marble, Malmesbury, Wilts.

H. Woodward.—Sixteen new Species added to the list of Crustacea from the Lias of England.

H. Woodward.—On some New Crustacea from the Eocene and Cretaceous Formations.

E. Ray Lankester.—On British Species of Cephalaspis and the Scotch Pteraspis.

Rev. J. D. La Touche.—On the Nodules in the Limestone of Wenlock Edge.

Professor Phillips (*President of the Association*).—On Glacial Striation.

Dr. L. Adams and Professor Busk.—First Report on the Exploration of the Maltese Caverns.

E. Whymper.—A few Notes on the Structure of the Matterhorn.

Prof. F. Römer.—On a Fossil Spider from the Coal-measures of Upper Silesia.

Principal Dawson.—On the Fossil Plants of the Post-pliocene Deposits of Canada in connection with the Climate of the period, and the Formation of Boulder-clay.

Rev. P. B. Brodie.—Remarks on the Drift in part of Warwickshire, and on the Evidence of Glacial Action which it affords.

A. Startin.—On the Drift in the Parish of Exhall, north of Coventry.

J. S. Whitten.—Observations on Supposed Glacial Drift in the neighbourhood of Coventry.

J. G. Jeffreys.—Notice of the Occurrence of certain Fossil Shells in the Sea-bed adjoining the Channel Islands.

C. Ketley.—On the Silurian Rocks and Fossils of Dudley.

Dr. H. B. Holl.—On the Pre-Cambrian Rocks of Central England.

Rev. P. B. Brodie.—On a Section of Lower Lias at Harbury, and on two new Species of Corals in the Lias of Warwickshire.

E. C. H. Day.—On the Lower Lias of Lyme Regis.

E. C. H. Day.—On a Head of *Hybodus De-la-Bechei.*

E. C. H. Day.—On the History of the Jurassic Seas, as evidenced by the History of the first Liassic Sea.

Rev. W. Holland.—Remarks on the Geology of Parts of the Sinaitic Peninsula.

D. Forbes.—On the Existence of Gold-bearing Eruptive Rocks in South America, which have made their appearance at two very distinct geological epochs.

G. Maw.—On some Fossiliferous Slates occurring between the Bunter Sandstone and Mountain Limestone of the Vale of Clwydd, North Wales. (See GEOL. MAG., Aug. 1865, p. 380.)

W. S. Mitchell.—On hitherto unrecorded Leaf-forms, &c., from Alum Bay, Isle of Wight.

L. Percival.—On a recent Example of the Formation of Pyrites in a South Staffordshire Coal-pit.

G. E. Roberts.—Notes on the Theory of Repulsion as illustrative of Physical Geology.

Rev. W. Fox.—On a New Wealden Saurian named *Polacanthus.* (See GEOL. MAG., Sept. 1865, p. 432.)

W. Von Haidinger.—On the Progress of the Imperial Geological Institute of the Austrian Empire.

L. P. Capewell.—Organic Remains of the S. Staffordshire Coal-field.

NOTICES OF GEOLOGICAL PAPERS READ BEFORE THE BRITISH ASSOCIATION.

GEOLOGICAL MAP OF THE RHENISH PROVINCES AND WESTPHALIA.

GEHEIMRATH VON-DECHEN and Prof. F. RÖMER explained the large Prussian geological map of the Rhenish Provinces and Westphalia. Only one part was exhibited, which illustrated some prominent points in relation to the Devonian rocks.—Prof. Römer said the general interest of the map for geologists in this country was, that it represented that part of Germany in which the Devonian rocks were more fully developed than in any other country, not excepting England or America. In Germany there were the three great divisions in regular superposition, with a better record of animal life than was to be found in the Devonian rocks in any other part of the world; and as the superposition of the strata was regular, there was the certainty that nothing was wanting between the Upper Devonian and the lowermost of the Carboniferous series.

ON A FOSSIL SPIDER FROM THE COAL-MEASURES, UPPER SILESIA, BY PROF. F. RÖMER.

THE specimen to which the communication referred was found in a piece of shale from the Coal-measures. It is beautifully preserved, and shows not only the four pairs of feet with all their segments and the two palpi, but even the coriaceous integument of the body, and the hairs attached to the feet. The interest of the discovery of this spider lies in the fact that hitherto spiders have not been known from any rocks older than the Jurassic, and that now the existence of them in the Palæozoic period is proved. From the resemblance to the recent genus *Lycosa*, and its occurrence in the Coal-measures, the name of *Protolycosa anthracophila* was given to the species.

MR. HENRY WOODWARD exhibited a NEW CHART of FOSSIL CRUSTACEA (accompanied by a descriptive Catalogue), designed and drawn by J. W. SALTER, F.G.S., and HENRY WOODWARD, F.G.S. Engraved by J. W. LOWRY, and published by J. W. LOWRY and J. TENNANT. London: 1865.

THE Crustacea—represented at the present day by the Crab and Lobster, and an infinite variety of other forms—play such an important part in organic nature, that they well deserve our attention; whilst their fossil remains show them to have been pre-eminently the oldest of all living forms, Foraminifera only excepted.

Their appearance is as varied as their structure is typical; whilst their distribution and habitat, both *recent* and *fossil*, are equally extensive. Take, for instance, the *Brachyura* (the Crabs). At the present day they occur as terrestrial, freshwater, and marine dwellers; whilst their remains go down into the Oolitic rocks, and occur in every higher formation, with marine and freshwater shells and leaves of land-plants; and their distribution may be exemplified by the curious fact, that for ages the Chinese have used the *fossil* Crabs from the island of Hainan in their Pharmacopœia as a highly esteemed medicine to remove 'heartburn' and indigestion.

On looking at the Chart, we shall perceive that it is divided both by transverse and vertical lines. The transverse lines separate the several geological formations, whilst the curving vertical ones indicate the different zoological orders.

We thus perceive, that of all the varied forms as we descend, when arrived at the oldest Silurian and Cambrian Rocks, only one, or at most two forms—Trilobites, and the bivalved and dish-shaped Crustacea (Phyllopods and Ostracods)—remain.

But although, in certain rocks, Trilobites alone are found, yet their diversified forms and their extreme beauty of sculpture and ornamentation to a large extent compensate for the absence of higher orders, whilst their numbers would seem to have been incredibly large; so large, indeed, that they have afforded subject of study to Barrande, Burmeister, Emmerich, Angelin Salter, and many other palæontologists. As this group ascends in time, we find those extravagantly ornamented and spinose forms such as *Paradoxides* and *Acidaspis* disappear, and only one genus, *Phillipsia* (named after the distinguished President of the British Association) survives to the Coal-measures, when the whole group disappears, and its place seems filled by Stomapods, Amphipods, and Isopods—forms to which Mr. C. Spence Bate has paid so much attention, and which in our Arctic seas attain as grand a development as did the Trilobites in the Silurian seas.

It would be an interesting question to investigate, whether the climate of the Silurian period was one of extreme cold, like that of our Arctic regions, and what *higher* animals fed upon those myriads of Trilobites which swarmed in every sea; for there were no '*Right Whales*' in Siluria, as in the Arctic seas at the present day, to devour them, and we cannot rest satisfied with the notion that they were only the consumers and not the consumed, or with that suggested by an eminent Continental palæontologist, that '*they ate one another.*'

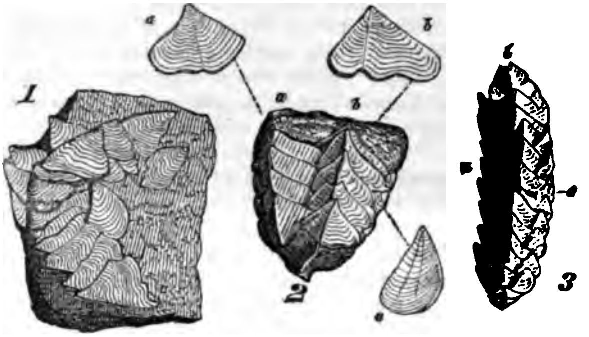
The next oldest and most remarkable group is that of the *Phyllopoda* and *Ostracoda*, the bivalved and disc-shaped Crustacea which abound in the Shales of Lanarkshire and almost every higher formation to the present day, often forming entire strata with their horny or shelly envelopes. This is *the only group* which seems to have been represented from the Cambrian Rocks to the present day.

Perhaps the most extraordinary and extinct order is that of the *Eurypterida*, the largest individuals of which attained a length of 6–7 feet, and are known to the Forfarshire quarrymen as the '*Sera-*

phim.' Although so unlike them in the form of their shelly covering and long body, Prof. Hall and others have shown the close relationship which exists between *Pterygotus* and *Limulus* (the King-crab) of the present day.

The *Xiphosura* have succeeded the *Eurypterida*, and held their own from the Coal-measures to modern times, occurring in the Oolites of Germany so like the recent forms as not to be distinguished from them *generically*.

Some may, perhaps, be surprised to find the group known as the *Cirripedia* (which is represented by the 'Barnacle' and 'Acorn-shell') placed with the Crustacea; but Profs. Hancock, Allman, Thompson, and Dr. Darwin have shown them to be true Crustacea, which, when young, rove freely through the sea, but, when they arrive at their final condition, become attached to foreign bodies, as wood, ships, rocks, &c. &c., and there pass the remainder of their days in a sessile or pedunculated shell.



TURRILEPAS WRIGHTII, H. Woodw. (*Chiton Wrightii*, De Kon.)
Fig. 1. Specimen from Mr. F. J. Hollier's collection.
Fig. 2. " Mr. Charles Ketley's "
Fig. 3. " Mr. H. Johnson's "

Figs *a*, *b*, *c*, represent the three forms of plates of which the several rows are composed in figs. 1–3, which bear the corresponding letters. The opercular valves are not known.

Until June 1865, the oldest Cirripede known was the *Pollicipes Rhæticus*, from the Rhætic beds of Somersetshire; but the author has just described* a new pedunculated Cirripede, with intersecting rows of plates (similar to *Loricula*), from the Wenlock Limestone and Shale (Upper Silurian) of Dudley, figures of which are given above.†

The Decapods (Crabs and Lobsters) date back their ancestry, the former to the *Oolite*, and the latter to the *Coal formation*. This group contains among its members those most highly organized genera, the *land* and *semi-aquatic Crabs*, whose gills (enclosed within the shell) are so beautifully defended from evaporation, that ey can wander at pleasure far away from water, and even defy e powerful heat of a tropical sun. Perhaps no stratum affords 'eater abundance of long-tailed forms (Lobsters) than the Litho- ·aphic Limestone of Solenhofen, so well worked out by Dr. Oppel ' Munich, the species of which are closely represented in the ias and Oolite of England.*

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* See Quart. Journ. Geol. Soc., vol. xxi. part iv.

† Two detached valves of this fossil were discovered by Mr. John Gray of Hagley, and described as a *Chiton* by M. De Koninck, Bulletins de l'Acad. de Bruxelles, 1857, 2nd series, vol. iii. p. 199, pl. 1, f. 2.

The top of the Chart is devoted to a small series of *Recent ypical Forms*, placed for comparison with the less perfect fossil mains. Short descriptions of each group have been prepared and lded to the Catalogue, which, it is hoped, will increase its useful- ;ss, and enhance the value of Mr. J. W. Lowry's beautiful en- ·avings.

On the Metamorphic Rocks and the Green Marbles of Connemara.†

By Prof. Harkness, F.R.S.

[T]HE author showed, by sections and maps, that the green marbles of Connemara were a local and peculiar development of light- :ey subcrystalline limestone which lies on the north side of the ıeiss rocks of the south of the Bens of Connemara. This lime- one dips conformably under these gneissic rocks. It is superposed ›nformably on quartz-rocks; and these quartz-rocks, with their ıperposed deposits, are thrown into numerous contortions in the onnemara country. Where they are most curtailed, the limestones ıve opened out in their lines of lamination, and into these openings ıe serpentinous matter, to which the green marble owes its colour, ıs been introduced. The metamorphic strata in the Connemara ›untry appertain to the Lower Silurians. They are the equivalents ; the Quartz-rocks, Upper Limestone, and Upper Gneiss of the .ighlands of Scotland, described by Sir R. I. Murchison. It has ›en stated that *Eozoön Canadense* occurs among the green marbles ' Connemara. The structure which has given rise to this opinion purely mineral, and has resulted from the deposition of Serpen- ıe upon Tremolite and asbestiform minerals.

CORRESPONDENCE.

EXPLORATION OF THE 'HOYLE'S MOUTH' CAVE, NEAR TENBY.

To the Editor of the Geological Magazine.

Sir,—In an 'outlier' of the Carboniferous Limestone, running right angles to the 'saddle-back' of Old Red Sandstone called the Ridgeway,' is a picturesquely situated cavern, well known to visitors Tenby by the name of 'Hoyle's Mouth.' Some interesting dis- veries of the remains of extinct and other animals have lately been ıde here by W. A. Sanford, Esq., and myself. As your readers may think a record of these discoveries not unsuited to your pages, we forward you a short account for insertion.

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* The author stated, at the British Association at Birmingham, that he had :ermined six genera and sixteen species from the Lias alone, which nearly ıemble oolitic forms from Bavaria.

† The 'Reader,' Sept. 16th.

'Hoyle's Mouth' consists of a lofty arched entrance, extending about 24 feet into the limestone hill. A tortuous passage, about 79 feet long, connects this with a small chamber 8 feet in diameter; another narrow passage, about 32 feet in length, leads into a second chamber, which is dome-shaped, about 11 feet in diameter, and has a funnel-shaped roof.

In this last-named chamber, which is at present the farthest part of the cave accessible, we found, beneath a mass of undisturbed breccia, the right and left femur, the os innominatum, some vertebræ, and other portions of the great Cave-bear: these were extracted in a very perfect state. Near them were the radius of *Hyæna spelæa*, and several loose bones and teeth of Fox, Deer, and Ox. In the passage about 32 feet from this, just where it leaves the small chamber above mentioned, were fragments of bones and an incisor of *Hyæna*; also, in the breccia, the bones of some large bird, and, what is of special interest, a worked flint, apparently of the 'barb' type. All these latter remains were below the level of the old stalagmitic floor, which had been partly broken through at this point. It is but a fair inference to draw, therefore, that they were contemporary with the animals of the Pleistocene—in fact, of the Mammoth Period.

It is worthy of remark, that there is evidence of the entrance of the sea at two distinct periods into the interior, as the bones in the last chamber were accompanied by rolled pebbles of various rocks; and on the sides of the first passage leading from the entrance were deposits of sea-shells—*Mytilus*, &c.—imbedded in a thin coating of stalagmite, exactly in the position in which such animals would have lived.

At the entrance, excavations were made in concert with the Rev. G. N. Smith, of Gumpeston, which confirmed in a remarkable manner the latter gentleman's previous discoveries relative to the antiquity of Man. Here we turned up a large quantity of worked flints of two different types; and in a layer of soil, which there is every reason to believe was perfectly free from previous disturbances, we found, in juxtaposition with these flints, an upper molar of *Megaceros*, together with teeth of Ox and Horse. Near this spot Mr. Smith had previously found a canine tooth of the great Cave-bear, an animal strictly contemporary with the *Megaceros*. Some of these worked stones were not flint, but of a stone not at present traceable to this neighbourhood. It appears to be a semi-vitrified trap, or semi-obsidian, of a dull green colour, with whitish specks and translucent edges, having precisely the same concoidal fracture as flint.

Though many flint-pebbles can be found on the sea-beaches in the neighbourhood, we have failed to discover any pebbles or blocks of this description of greenstone, though we have diligently searched for them from here to St. David's Head.

Finally, remains of Man were not absent; for, about 40 feet from the mouth of the cave, below the level of the stalagmitic floor, and under a broken shelf of the same, we found a portion of a human lower jaw, together with a human calcaneum. These latter remains from their position *may be* of the date of the worked flints, or they may be of any date greater or less than a few hundred years since.

The determination of the bones is due to Mr. Sanford.

H. H. WINWOOD.

TENBY: *August* 22, 1865.

GLACIATION IN DEVON AND ITS BORDERS.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—I do not know whether anything has been published about ice-marks on the rocks of Exmoor, Dartmoor, or the other hills of the West of England. Perhaps, therefore, you will allow me to put on record a case of glaciation which I met with yesterday, as striking as any in the Killarney or Glengariff country in the south-west of Ireland. It is on the banks of the river Exe, about a mile and a half north-east of this little town, and about a quarter of a mile north of the ruins of Barlynch Abbey. The Exe runs rapidly down a beautifully wooded glen some 400 feet deep, and makes a sharp turn at the point indicated, where a mass of hard grits in the upper part of the true Old Red Sandstone juts out to the west, dipping south, and showing a steep little escarpment looking north up the valley. At the extreme point of this crag, where the valley is contracted to a quarter of its usual width, part of the face of the rock, 20 yards long and 20 feet high, looking up the river, is grooved, polished and scratched in parallel lines, nearly horizontal, but slightly inclined towards the bed of the river. It looks like a gigantic cornice-moulding, some of the more prominent ribs about 2 or 3 feet apart, others only 6 or 8 inches, but all undercut with a sharp symmetrically-rounded fluting to a depth of from 3 to 4 inches. The surfaces between the most prominent cornices are more slightly fluted, with lesser ribs, and the whole smoothed over with parallel rubbing-marks, exactly as may be seen at the sides of a modern glacier wherever a projecting crag intrudes itself into its course.

The absence of anything like boulder-clay, and the rarity of far-transported boulders, are circumstances in which this district also resembles the Killarney and Glengariff country, as well as in the identity of the rocks and character of the scenery.

J. BEETE JUKES.

DULVERTON: *Sept.* 19.

PRIMARY AND SECONDARY GLACIAL STRIÆ.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—It is rather remarkable that none of the writers on Glacial Phenomena have mentioned *Primary* and *Secondary* sets of Striæ as having been observed in the localities of which they have given descriptions; and that they do not occur would appear to me rather remarkable, as in all the places in Ireland that I have *carefully* examined I found them.

The *Primary Striæ* and *Grooves* in this country have a general bearing of about NNE. and SSW., having a similar bearing to the 'Crag and Tail' and the 'Dressed Hummocks.' They are only slightly deflected while passing over hills some nearly 2,000 feet high, and seem to have been made by the movement of the Field, or *Nappes*, of ice that covered this country before the ***Boulder-drift Period.***

The *Secondary Striæ* always coincide with the fall of the ground, nearly every valley having a different system : they as often run across the 'Crag and Tail' and 'Dressed Hummocks,' as not. They cut the Primary Striæ and often obliterate them, and are sometimes accompanied by grooves; but this is not often the case. They seem to have been formed when the Ice-sheet, or *Nappes*, was finally breaking up and sliding down the various hills and valleys.

I have observed *Primary* and *Secondary* Striæ in the following localities:—In the Valley of Galway, from Atheney to Golam Head; in the valley between the Burren Mountain, to Clare, and Slieve Aughta, from Gort to near Ennis; in the Ballynahinch Valley, from Oughterard to near Clifton; in the valley in which Lough Corrib is now situated, from Maum to Kylebeg; in the valley now occupied by the Killeries; and in the various small valleys that occur among the hills in Jar-Connaught (christened by the English, Connemara)—nearly every one of which has its own system of Secondary Striæ. They can also be well observed on the eastern slopes of Slieve Bawn (which rises as a 'Crag and Tail' in the plain about ten miles west of Longford), where the Primary Striæ bear with the lie of the hill, while the Secondary Striæ run down its slopes. That in none of the places that I have mentioned are the Striæ due to local glaciation, is proved by their occurring under the *Boulder-drift.*

J. HENRY KINAHAN.

OUGHTERARD, IRELAND: *Aug.* 19, 1865.

DISCOVERY OF ERECT STEMS OF FOSSIL TREES IN TRAPPEAN ASH IN ARRAN.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—The occurrence of beds of stratified trappean ash resting upon fossiliferous strata is not uncommon in the Coal-measures of the West of Scotland; but very rarely such beds are found to enclose organic remains, and hitherto, so far as I am aware, no beds have been found in situations where they can be studied and explored systematically.

The north-eastern shores of Arran, exhibiting beautiful sections of the Carboniferous series, have been surveyed and described by various eminent geologists, and on their authority the beds of volcanic origin interstratified with the coal, shale, and sandstone of the series have been invariably accepted as either intercalated, or intrusive, trap-beds, 'trap-dikes,' or 'outbursts of trap;' nor is it easy, on a mere cursory survey, to ascribe any other character to them.

A prolonged stay during the summer on these interesting shores has, however, enabled me to study these beds more minutely, and, on closer examination, the great majority of them are found to consist purely volcanic ash—mostly of a clearly sedimentary origin—posing upon thin seams of coal and shale, and enclosing a con- lerable number of fossil plants in a beautiful state of preservation. Up to the present time, I have accurately surveyed a distance of ly about 400 feet along the shore; and within this comparatively rrow area are found no less than ten distinct beds of trappean ash. Trunks of trees, 18 to 24 inches in diameter, and 2 to 3 feet in ight, standing erect upon the original beds of thin coal and shale on which they grew, and covered by layers of ash 2 to 3 feet in ickness, are found regularly dispersed over the area; while the h overlying them, in which they are embedded, contains numerous anches, from 4 inches in diameter down to the minutest dimensions, me of the impressions displaying an almost feathery foliage, as ough suddenly covered up before the vegetation had had time to cay or become water-worn. The larger branches remain perfectly und, and show the pith in an admirable state of preservation; and e cellular tissue, filled up with mineral matter, is plainly visible to e naked eye.

The specimens of the smaller branches thus far obtained indicate e genera *Lepidodendron* and *Halonia*; but I have had no oppor- nity as yet of having them examined microscopically. As far as an be determined by a simple botanical glass, the structure is very imilar to the sections of *Lepidodendron*, &c. figured and described y Mr. Binney in the 'Quarterly Journal of the Geological Society' r January 1862.

The whole of the beds belong to the Lower Carboniferous series nderlying the Producta-limestones, and there are indications of eds of a similar character both above and below those described. The mineralogical character of the beds is highly interesting, and as been examined jointly with me by my friend and colleague, Mr. John Young, of the Hunterian Museum. A joint paper on the ubject will be laid by us before the Geological Society of Glasgow t an early date: meanwhile, if you think the announcement of the iscovery of fossil plants under the circumstances stated may be nteresting to your geological readers generally, the above details re quite at your service, and I remain, dear Sir,

Yours very truly, E. A. WÜNSCH,

NDERSONIAN UNIVERSITY BUILDINGS, V. P. Geol. Soc., Glasgow.
GLASGOW: *Sept.* 9, 1865.

NOTE ON THE ANALYSIS OF A DEPOSIT CONTAINING SULPHATE OF BARYTA.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—At a late meeting of the Glasgow Geological Society, Mr. Thomson exhibited a compact mass which had been deposited in a pipe, apparently a square wooden one, used for conveying water from Harton Pit, near South Shields, which is about 200 fathoms deep.

The deposit is a hard, compact, light-brown mass, with dark-brown streaks running through it. The portion shown was about

1 foot long, 5 inches square, and 2 inches thick, and appears to have almost entirely filled up the pipe, retaining its square form throughout: the whole was deposited in the short space of from six to nine months.

The chemical composition, which is rather remarkable, is as follows:—

(Sp. gr. at 15·5 C., 3·646.)

	(1)	(2)
Sulphate of Baryta	83·01	83·6
Ferric Oxide	3·77	5·5
Carbonate of Lime	9·46	8·2
Alumina	traces	1·0
Water	2·02	2·0
	99·16	100·3

No. 1 was from the centre of the deposit, No. 2 from the outside. This analysis was made by a friend.

The only reference which I have been able to find with regard to the occurrence of sulphate of baryta in coal-pits is in a paper by Messrs. R. C. Clapham and T. Daglish, read before the British Association at Newcastle in 1863. It is there stated that Mr. Foster had found quite a large mass: Dr. Richardson also had observed it in the waters of Walker Colliery.—Yours truly,

J. WALLACE YOUNG.

GLASGOW.

DENUDATION, UNCONFORMABILITY, AND THE VALE OF CLWYD.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—Geological notions, like all others, occasionally swing pendulum-like from one extreme to the other. The old controversy between the respective importance of Fire and Water has not ceased; though, judging from the number of important results which are now attributed to its denuding power, Water is evidently in the ascendant. Believing myself that these results are rather over-estimated, I am induced to offer to your readers the following remarks.

A gap in the order of strata—as, for example, Carboniferous Limestone resting upon Lower Silurian rocks, or the Trias, as in the Vale of Clwyd, supposed to rest upon the Carboniferous Limestone—does not *necessarily* imply the denudation of the strata missing from between them; for it is possible to conceive that towards the close of the deposition (or indeed at any period during its deposition) of any group of strata, the deposit might, in any portion, or the whole of it, be raised above the sea-level, and so remain, while newer deposits were being formed around it; and so a *hiatus* in the order of the strata would be caused, which would be greater or less in proportion to the time the relative positions of sea and land remained unchanged.

Thus, suppose in any particular district the sea-bottom to have been elevated towards the close of the Lower Silurian period, and to have remained above the sea-level until the Old Red Sandstone was deposited, and then be again submerged, we should in that district miss the whole of the Upper Silurian rocks; and the Old Red Sandstone and the Carboniferous Limestone would rest directly upon the Lower Silurian strata, just as it is seen to do on the west of Oswestry. Of course, the land so raised would become subject to the influence of the atmosphere and rain, and its outlines would become modified in proportion to the power of these agents and the extent of surface so exposed.

The thinness, too, of a 'Formation' at a given point does not *necessarily imply* a previous 'erosion' or denudation of the strata at that point. For it is but reasonable, and in accordance with what we know, to suppose that while the deposition of matter may be the same in character over an extended area, it may yet differ greatly at various points in the *rate* at which it is deposited, liable as the deposition is to be affected by currents, by the nature of the solids supplying the materials, by the presence and intensity, or otherwise, of sub-marine springs, &c. Thus, whilst over the large area supposed we should find beds similar in their general character, and occupying the same stratigraphical position, we should also find local variation as to colour, texture, and thickness.

It apears to me also, that Unconformability of strata does not *necessarily* imply a lengthened lapse of time, or a change in the mineral or organic constituents of the deposit. It is easy and reasonable, as it appears to me, to conceive that, during the formation of any deposit, the sea-bottom in any portion of it may be tilted up from a nearly horizontal to a highly inclined position, and the work of deposition go on again with scarcely any interruption; and thus we should have strata of the same age (geologically speaking) resting unconformably on each other, while, on the other hand, a much older 'formation' which had been elevated, as I have before supposed, and remained so, whilst newer deposits were forming about it, may again be depressed, and in such a position as that the new matter shall be deposited conformably to it.

It appears to me that no theory of Denudation or Unconformability is universally applicable, but both are liable to be affected by local and particular causes: hence the need of great and constant discrimination in all geological theorizing. To some of your readers these remarks may appear mere truisms; nevertheless I do think that they are too often forgotten. Thus, in the August Number of this Magazine, Mr. Maw argues from the supposed aggregate thinness of the Carboniferous Limestone near the head of the Vale of Clwyd, in favour of a great erosion of that formation prior to the deposition of the Trias; whereas, if the foregoing remarks are true, the supposed erosion is not necessarily consequent upon the thinness of the Limestone. And then we find no less an authority than Mr. Jukes, in his lecture at Birmingham before the British Association, assuming it as an axiom that where the Carboniferous Limestone is present, it was once covered by the Coal-measures. Here, again, your readers will see that while this might have been the case, and probably in some instances was so, it does not follow logically that any group of strata now exposed on the surface was once overlain by the group next in geological order. Though, singularly enough, in the Vale of Clwyd, which has been singled out as an illustration of former denuding power, the edges of the Coal-measures (supposed to have been washed away) were observed cropping up on the western side of the vale, between the Limestone and Sandstone, when the Rhyl and Denbigh Railway was in course of construction; and then the *uppermost* beds of the Carboniferous Limestone, as developed in North Wales, are seen in the immediate vicinity of Mr. Maw's section; so that the supposed erosion could not have taken place. From the great similarity of the beds described by Mr. Maw as Permian, and those of the Millstone-grit near this town, I should not be surprised if the 'Purple Shales and Sandstones' of his section should be found to belong to that member of the Carboniferous series; though, from one or more causes, but not necessarily by Denudation or Erosion, they do not assume the massive proportions to which in other places they have attained.

Apologising for the length of this communication, I am, yours truly,
D. C. DAVIES.

OSWESTRY: *Sept.* 13, 1865.

MISCELLANEOUS.

SILVER PEAK is believed to be as pre-eminent over all silver-mountains, as the Iron Mountain of Missouri is superior to all other iron-deposits. It is situated east of San Francisco, on the eastern side of the Sierra Nevada, and nearly one degree south of the city of Austin. It is some two miles from Castle Mount, an old extinct crater, about 5,000 ft. above sea-level. Near Silver Peak is an extensive deposit of salt, and not far distant a hill of pure sulphur. The whole country has a naked appearance, being quite destitute of vegetation, and bristles with mountains scattered over a plain of great extent. The dreaded 'Valley of Death,' upon the plains of which, along the 'old Spanish trail,' travellers have suffered so much, lies but a short distance to the south-east of the crater of Silver Peak. Little Salt Lake, in Southern Utah, lies directly east of Silver Peak. At first the searchers after deposits of the precious metals confined themselves to the Pacific side of the Sierra Nevada; but discoveries in New Mexico, Arizona, and Virginia city induced a thorough examination of the east side of that range. This proved a great success, the most brilliant result of which is found in the neighbourhood of Austin, on the line of the great overland mail, where a city has sprung up within three years which, Senator Nye says, contains a population of 10,000. From along this line of exploration the miners are rapidly extending their operations, both north and south. Recently (within six months) they came upon this immense deposit near Castle Mount. Twelve exceedingly rich lodes, or 'ledges' as the miners call them, were discovered on that single mountain. This is believed to be the most valuable discovery yet developed. The specimens—a great number of which have been brought to New York by Colonel Catherwood—are certainly very remarkable, and are well worthy of attention. If there is no mistake—and with the specimens actually before us we do not see how there can be—a new deposit, superior even to the Cornstock lode, which has furnished so many millions of silver, is about to pour into our market its limitless supply of this precious metal.—*New York Journal of Commerce.*

THE NEW ZEALAND GOLD-FIELDS.—The *Argus* of April 27, 1865, states that further intelligence from the Okitiki district only confirms the opinion before expressed, that too many men had proceeded thither, and that a large proportion of them would have to leave it before the winter sets in. There is no doubt of extensive fields being ultimately opened within a few miles of the coast; but the difficulty of getting through the country is so great, and provisions are so dear at all the outlying places, that men without a good supply of money need not go prospecting. The climate, too, is very wet; and this much increases the hardship to those not well provided with tents and other requisites. The men at work appear to be getting good returns; but the question with one-half the late arrivals is, how they are to get away again. And without money to pay their passage by sea, the answer is not easy, for the track over the mountains has become almost impossible in places, and those who attempt it suffer much, if they succeed in getting through at all. In the Otago district, there appears no lack of work for those inclined to stick to it, and several cases of more than ordinary success are mentioned. A well-defined and regular lead of gold is said to have been opened in the Cardrona Valley, and some of the claims on it are rich. The mountains being almost clear of snow, the rivers are expected to be unusually low this winter, and it is hoped that much gold will be got from the Molyneaux, not only out of the bed of the river, but also out of the banks, for some of the richest deposits lately found were at some distance above the present limits of the stream.

MANUFACTURE OF PARAFFINE-OIL.—Public attention has already been directed to the discovery, in different parts of the colony, of the *mineral* from which paraffine-oil—more commonly known as kerosene-oil—can be obtained. Near Hartley, and also near Wollongong, extensive seams of this mineral have been found, differing considerably from each other in appearance, in fracture, and in yield, but both available for the manufacture of this now universally used luminating fluid. The seam near Hartley (discovered in consequence of some pieces of the mineral outcropping in the alluvium) is five and a half feet in thickness, and is worked through a tunnel; its situation is in the Vale of Clwyd, about four miles from Little Hartley. The railway to Bathurst, now in course of formation, will cross the Darling Causeway a little more than a mile from the spot. The mineral is of a dark-brownish colour; it is extremely tough, so that if struck with a hammer the instrument will bound off as it would from a block of wood; it has a conchoidal fracture, and does not powder when broken. It is stated that this mineral resembles that worked in Scotland, and known as Bog-head Coal, which for gas-making was estimated to be six and a half times the value of ordinary coal, and which had been largely used under Young's patent for the extraction of paraffine-oil. Beautiful dyes and other valuable products had been made from the residuum, after the extraction of the oil and the paraffine. It is also stated that the Hartley mineral is superior to that of the Boghead, in consequence of its yielding a larger quantity of gas, and therefore of oil, and also of its freeness from sulphur. Two feet of the gas made from this mineral gave, it is said, a greater illuminating power than five feet of gas obtained from ordinary coal. It is estimated that a ton of the mineral would yield about 140 gallons of crude oil. The annual import of kerosene-oil into this colony is set down at 200,000 gallons, and that into the whole of the Australian colonies at about 1,000,000 gallons; and it is confidently believed that the oil could be produced here at a lower price than it could be imported from America, and that therefore an extensive and valuable source of productive wealth would be opened up.—*Sydney Mail*, May 5, 1865.

DISCOVERY OF A PIECE OF FOSSIL IVORY IN A CAVERN IN PERIGORD BEARING A REPRESENTATION OF A MAMMOTH.—On 21st August last, M. MILNE-EDWARDS communicated a letter from M. Lartet to the Academy of Sciences of France, on the discovery (May 1864), in the ossiferous deposit of La Madelaine, of fragments of a plate of ivory, upon the surface of which rude lines of the figure of some animal had been cut. The late Dr. Falconer (who was present with MM. Lartet and Christy when the drawing was found) at once recognized the head to be that of an Elephant, and, from a number of lines on the neck, that it was intended to represent an Elephant with a long mane—*in fact*, the 'Mammoth.' As a figure of this interesting relic has not yet been published, it would be unwise to pronounce finally upon its authenticity; but we have the favourable opinion of MM. Lartet, Milne-Edwards, Quatrefages, Desnoyers, and of our own distinguished countrymen, the late Dr. Hugh Falconer, and Mr. A .W. Franks, President of the Society of Antiquaries (who have seen and examined it).*

The importance of this positive evidence of the contemporaneity of Man with the Mammoth in the South of France, cannot, we think, be too highly estimated.

Numerous carvings on bone and horn, accurately representing the Reindeer, Musk-ox, Horse, and other animals, found in these same caverns of Dordogne, afford ample proof of the artistic skill of these ancient people, and of their ability to represent the wild animals with which they were familiar in the chase.

It is extremely improbable that they would have drawn an Elephant from imagination; how much more improbable that they should, without knowing the Mammoth, have depicted not only his general form, but represented him as a hairy beast with a thick mane!—as described by M. Adams in 1799, from the specimen found imbedded in ice at the mouth of the Lena in Siberia, some of the long hair of which may be seen in the British Museum.

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* See *Comptes Rendus*, No. 8, August 1865.

THE

GEOLOGICAL MAGAZINE.

No. XVII.—NOVEMBER 1865.

ORIGINAL ARTICLES.

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I. NOTE ON THE PALÆONTOLOGY OF THE RHÆTIC (PENARTH*) BEDS IN WESTERN AND CENTRAL SOMERSET.

By W. BOYD DAWKINS, M.A., OXON., F.G.S., of the Geological Survey of Great Britain.

A BRIEF notice of some of the more important Rhætic Fossils in the district described in this MAGAZINE (vol. i. p. 257) may perhaps be some guide to the identification of the beds in other British localities.

Of the more common and characteristic forms, *Pecten Valoniensis* and *Sargodon tomicus* were derived from the same layer as that which yielded a tooth of *Hypsiprymnopsis Rhæticus* below the bone-bed. The former comprises two bands of limestone in the upper portion of the Avicula Contorta series, or middle member, at Watchet and Uphill. My colleagues, Messrs. Etheridge and Bristow, have also found it to occupy the same horizon at Penarth. The chisel-shaped teeth of the latter in the unworn state, having their cutting edge traversed by a notch, were probably the anterior incisiform teeth of a fish allied to *Sargus*. Teeth of *Acrodus minimus* are enormously abundant in the Middle Rhætic series. *Pleurophorus angulatus* is also very abundant in the same horizon and forms a layer of 'Pleurophorus' limestone. (See Quart. Journ. Geol. Soc. vol. xx. p. 396.) *Avicula contorta* is restricted to the Middle Rhætic division, while *Ostrea interstriata* is common both to the middle and upper divisions; and *Cardium Rhæticum* is found throughout. These last three species are figured in the plates accom-

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* Since the paper published in the GEOLOGICAL MAGAZINE (Vol. I., p. 257) was written, Sir Roderick Murchison, F.R.S., Mr. Bristow, F.R.S., and Mr. Etheridge, F.G.S., on an examination of the beds therein described, and also of the corresponding strata in South Wales, have determined upon naming them the Penarth series, from their great development at that place, and from the desirability of having a British name for a series of rocks well represented in the British Isles, and shown by a distinct colour on the Map of the Geological Survey.—[See British Association Reports in GEOLOGICAL MAGAZINE, Vol. I., p. 236.]

GENERA AND SPECIES	Lower Rhætic	Middle Rhætic	White Lias, or Upper Rhætic	Lower Lias, or Ammonites-planorbis-zone
Hypsiprymnopsis Rhæticus, *Dawkins*	—			
Acrodus minimus, *Ag.*	—	—		
A. acutus, *Ag.*		—		
Hybodus plicatilis, *Ag.*		—		
H. pyramidalis, *Ag.*		—		
H. reticulatus, *Ag.*		—		
Gyrolepis Alberti, *Ag.*	—	—		
G. tenuistriatus, *Ag.*	—	—		
Sargodon Tomicus, *Plien.*	—	—		
Saurichthys acuminatus, *Ag.*		—		
S. apicalis, *Ag.*	—	—		
Squaloraia		—		
Desmacanthus cloacinus, *Quenst.*		—		
Beloteuthis, *vel* Geoteuthis, sp.	—			
Axinus cloacinus, *Op. & Suess*		—		
A. elongatus, *Moore*		—		
Anatina Suessi, *Oppel.*		—		
A. præcursor, *Quenst.*		—		
Anatina?		—		
Cardinia?		—		
Pleurophorus elongatus, *Moore*		—		
P. angulatus, *Moore*		—		
Pleurophorus, sp.			—	
Myophoria postera, *Quenst.*		—		
Pteromya Crowcombeia, *Moore*		—		
Avicula contorta, *Portl.*		—		
A. solitaria (?), *Moore*		—		
Avicula?			—	
Lima præcursor, *Quenst.*		—		
L. pectinoides, *Sow.*			—	—
L. punctata, *Sow.*			—	—
Modiola minima, *Sow.*	—	—	—	
M. Hillana (juv.), *Sow.*			—	
Gervillia præcursor, *Quenst.*	—			
Placunopsis Alpina, *Winkl.*		—		
Ostrea interstriata, *Emm.*			—	
O. Liassica, *Strickl.*			—	—
Pecten Valoniensis, *Defr.*	—	—		
P. Rhæticus, *Quenst.*		—		
Pecten?			—	
Trigonia curvirostris, *Quenst.*		—		
Cypricardia Suevica, *Moore*		—		
Myacites striatogranulata, *Moore*	—			
Pullastra arenicola, *Strickl.*	—	—		
Cardium Rhæticum, *Merian*	—	—	—	
Leda?		—		
Cerithium Henrici, *Martin*		—		
Chemnitzia nitida, *Moore*		—		
Chemnitzia?	—		—	
Cylindrites elongatus, *Moore*		—		
Coprolites	—	—		
Annelida	—			
Serpulæ			—	
Cladophyllia?			—	
Montlivaltia?			—	
Fucoides	—			

panying Mr. C. Moore's paper in the Geological Society's Journal, vol. xvii. pl. 15 and 16. The two latter are found in large numbers in the White Lias or upper member, along with *Modiola minima*.

The foregoing table gives the range of the Rhætic Fauna in the district which I have examined. Its lacunæ, so far as relates to other localities in Britain and Ireland, may be filled up by a reference to the papers of Dr. Wright, F.G.S., and Mr. R. Tate, F.G.S. (Quart. Journ. Geol. Soc. vol. xvi. and vol. xx.).

To this list of the Fauna of the district a large addition must be made from the collection and the paper of Mr. Charles Moore, F.G.S. already mentioned.

Among the mammalia that this gentleman discovered with so much diligence in a fissure of the Mountain Limestone near Frome are teeth of *Microlestes antiquus* (Plieninger), or the small mammal first found in the bone-breccia of Diegerloch, together with several forms which, as yet wanting names, probably belong to diverse Marsupial families. On comparing them with the recent Marsupial remains in the Hunterian and British Museums, I find that two stout recurved canines, oval in section, bear a striking resemblance in form to those of the opossum (*Didelphys*) or the *Myrmecobius*; while a third is remarkably akin to the lower canine of *Peragalea* or *Dasyurus*. There can be little doubt that these three canines indicate the presence of animals of carnivorous or insectivorous habit on the land of the Rhætic period. One trenchant recurved tooth, on the other hand, compressed parallel to the median line, bears the form of the small upper canine of the Kangaroo-rat of Australia. Three small procumbent incisiform teeth, also bearing a strong resemblance to the upper incisors of *Hypsiprymnus*, point towards the phytophagous group of the Marsupials; the Kangaroo-rats (*Hypsiprymnidæ*), and their allies. Of the tubercular molars one cannot be differentiated from the second true molar of *Plagiaulax minor* (Falc.) figured by Dr. Falconer, F.R.S., in the Geological Society's Journal, vol. xviii. p. 367, fig. 15), to which genus I have little hesitation in ascribing it. The genus *Plagiaulax* therefore existed on the Secondary continent from the period of the deposit of the Purbeck strata down to that of the Penarth or Rhætic beds.

The rest of the mammalian teeth differ from those of any known existing or extinct mammal, and possibly may have belonged to the *Microlestes* of Diegerloch, of which but one tooth is at present known. The interest of science demands that this remarkable collection of mammalian teeth should be figured and described as soon as possible. The above scanty notes from my note-book are merely published that they may not lie fallow for years, like a similar collection made long ago, for a determination of which we are still anxiously waiting. Teeth of *Lepidotus* are also to be added to the list found by Mr. Moore at Beer, Vallis, and Holwell; together with *Anatina Suessii*, Oppel; *Arca Lycettii*, Moore; *Axinus concentricus*, and *A. depressus*, Moore; *Discina Townshendii*, Davidson; *Gervillia ornata*, Moore; *Ostrea fimbriata*, Moore; *Trochus nudus*, and *T. Waltoni*, Moore; *Leda Titei*, Moore; *Straparolus Suessii*, M[illegible]

Cerithium constrictum, *C. decoratum*, *C. cylindricum*, and *C. Rhæticum*, Moore; *Chiton Rhæticus*, Moore; *Cylindrites fusiformis*, *C. ovalis*, and *C. oviformis*, Moore; *Naïdita acuminata*, Buckman; *Cypris liassica*, Brodie; *Estheria minuta*, Alberti; and *Pollicipes Rhæticus*, Moore; figures and descriptions of most of these are to be found in Mr. Charles Moore's valuable paper in the Quarterly Journal of the Geological Society, vol. xvii. p. 498–516, pl. 15, 16.

II. ON CAULOPTERIS PUNCTATA, Goepp., A TREE-FERN FROM THE UPPER GREENSAND OF SHAFTESBURY IN DORSETSHIRE.

By WILLIAM CARRUTHERS, F.L.S., of the British Museum.

(Plate XIII.)

THE Upper Greensand is a marine formation. Dr. Fitton, in his elaborate Memoir on 'The Strata below the Chalk' (Geol. Trans., Second Series, Vol. IV.), has enumerated 60 species of Mollusca, 2 Annelids, 3 Echinoderms, and 2 Protozoons from the beds in the South of England belonging to this period. These numbers have been more than doubled since the publication of that paper. They still retain the same proportions; but the fossils which Dr. Fitton characterised as 'fish remains' have been referred to 9 genera, and there have been added 4 genera of Saurians. As might be expected, very few vegetable remains have been observed. Dr. Fitton records the occurrence of some impressions of leaves. The remains of what appear to be sea-weeds are occasionally met with. Specimens of fossil wood have also been found. William Cunnington, Esq. F.G.S., of Devizes, who has kindly, through the Editor, furnished me with some particulars regarding the Upper Greensand deposits near Shaftesbury, informs me that for forty years he has been collecting the fossils of these beds, and that during that time he has obtained about thirty specimens of woods, many of them certainly drift woods, as they had been attacked by lithophagous molluscs. I have examined all the specimens of these woods contained in the collections of the British Museum, and I find that they are all Coniferous. Little more than this can be said. The woody fibres contain a single row of discs, and I have not detected any spiral fibres associated with them.

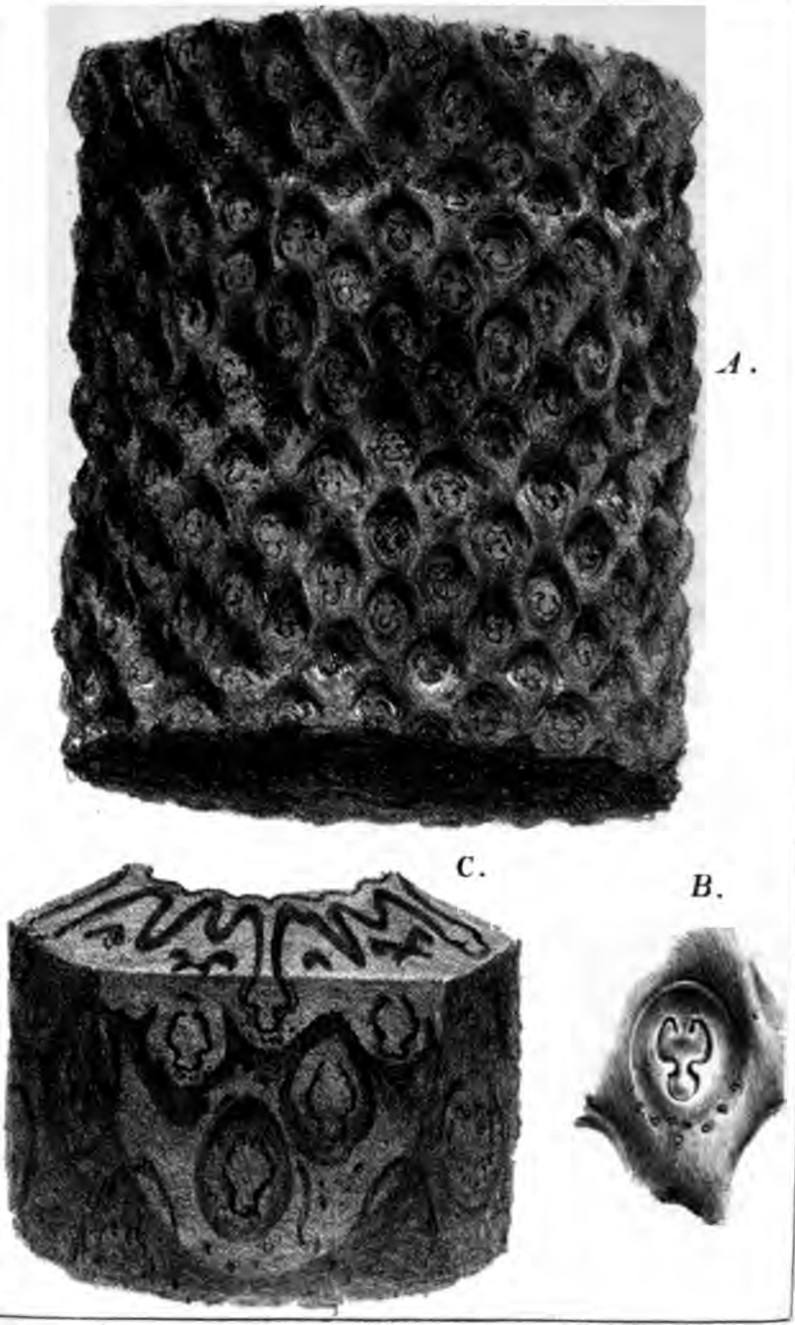
With so few vegetable remains, it is thus of no small interest to find the stem of a Tree-fern in these beds. The specimen, of which a portion is figured, is in the Palæontological collection of the British Museum. It is a cast in sandstone, and is only a fragment, 14 inches long by 6 inches broad; other portions of the same trunk are in the collections of the Revs. T. Stanton and J. Penny. The stem had been floated out to sea, and been tossed about or rubbed till the bases of the stipes were worn off, and nothing remained but the woody portion marked with the scars of the stipes. The bed in which it was buried formed an admirable matrix around the specimen, which in process of time entirely disappeared, and its place was ultimately filled with sand, which has preserved on its surface the most delicate markings left in the cavity. No structure xists in the interior. That the specimen was floated out to sea efore being buried, there can be little doubt from its abraded condition; but this is the more certain from a specimen of the same pecies (perhaps the same individual even) in the possession of the Rev. T. Stanton, which has, as Mr. Cunnington informs me, shells f *Exogyra* adhering to it.

The specimen figured in Plate XIII. is somewhat compressed. The characteristic markings are absent along a narrow longitudinal ortion of one of the flattened surfaces; this probably represents he opening in the mould through which the sand entered. The scars are small in comparison with most recent ferns. They are arranged in a spiral cycle, which completes a single revolution in 20 inches of the stem, and contains 34 scars in each cycle. The scars are of an oval form, and contain two series of markings produced by the vascular bundles (Plate XIII., fig. B.). The inner one is composed of a continuous plate of vascular tissue, and the outer consists of 8 or 9 separate small round bundles distributed equally round the lower half of the scar. The inner plate passed up through the centre of the stipe, while the separate bundles strengthened its under surface. The inner plate presents a somewhat complex figure; it consists of a constricted centre with a roundish lobe below, and two erect lobes separated by a sinus which forms a break in the vascular plate.

This fossil was originally described by Sternberg, and named by him *Lepidodendron punctatum.* Martius, observing its affinity to the recent *Filices*, gave it the name of *Filicites punctatus.* Brongniart, though noticing the resemblance between its leaf scar and those of some recent ferns, referred it to the genus *Sigillaria.* Goeppert went as far as the materials enabled him, when he described it as *Caulopteris punctata.* Presl altered the generic name into *Protopteris*, and Corda sets aside the specific denomination by which it was known to all preceding authors, and, for no apparent reason, names it after its discoverer *Protopteris Sternbergi.* The locality given by Sternberg, 'in saxo arenaceo formationis Lithanthracum,' was referred by him to the Coal-measures; and accepting this determination like all who have after him treated of this fossil, I had almost added another to this list of synonymes, having given the Shaftesbury fern-stem the manuscript name of *Caulopteris Dicksonioides*, which unfortunately, before I had investigated its history, I permitted to be inserted on the plate. Dr. Fritsch of Prague has since informed me, that the bed from which *Caulopteris punctata* was obtained is Upper Greensand, and that, in 1849, Dormitzen found in the same stratum two additional species, which M. Krejči figured and described in the Bohemian Journal 'Ziva' for 1853, viz. *Alsophilina Kauniciana*, and *Oncopteris Nettwalli.* These were preserved as red sandstone casts, like the specimens from Shaftesbury, but they are much more compressed. They have a diameter of 6 inches, and he considers they may have attained a height of 30 or 40 feet. He thinks that the *Cyatheæ* of South America and the West Indies are their nearest living representatives. The specimens occur in a thin coal-seam, which is covered by a red sandstone rock, and rests on a bed of grayish blue clay, in which are found the remains of plants peculiar to the Chalk. The beds at Kaunitz are then of the same age as those at Shaftesbury, and there can be no doubt that the fossil is the same species.

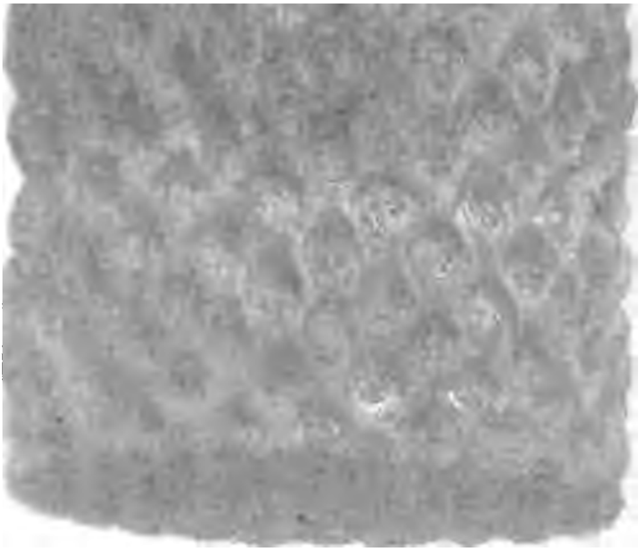
The only means of determining the affinities of this fern are to be obtained from the leaf-scars. Both Brongniart and Goeppert have shown that these are of considerable systematic value. The figures in the scars are produced by the vascular bundles; and as these are related to the form of the frond, and even to the spore-bearing nerve, it is evident that allied plants will agree more or less in the arrangement of the vascular bundles. This subject has not yet received the attention in tree-ferns that it deserves. The arrangement of the bundles in the stemless species found in Europe has been described by Douval-Jouve, Ogilvie, Church, &c.; and their importance has been shown in their giving additional distinguishing characters to allied species, and in uniting others that had been separated on insufficient data. The peculiarities I have described in the leaf-scars of *Caulopteris punctata*, are remarkably like what we find in the recent genus *Dicksonia*. There is placed on the plate a drawing of a portion of the stem of *Dicksonia antarctica* for comparison (Fig. c.). Were the scars sufficient to determine the species I would not hesitate to place it in this genus, but all the parts employed by botanists in the classification of ferns are wanting. In the manuscript name which I had given to it, I expressed as much regarding its affinities as the materials enable me—it is a *Dicksonia-like fern-stem.* Not only in the structure of the scar, but also in its small size, and in the consequent small frond, it is nearer to *Dicksonia* than to *Cyathea.*

The specimen exhibits five very slight constrictions produced by seasonal interruptions to the growth, three of which are shown in the plate. In the fern-stems from tropical and sub-tropical regions which I have examined, I can find no evidence of such interruptions in the growth. I have, however, observed similar constrictions in stems of native ferns grown under favourable circumstances in Britain. Some years ago I obtained, in a gully on the side of Ben Lomond, specimens of *Lastræa Filix-mas* with true stems a foot in length, which showed that they were then in their fourth year by the three constrictions on the stems; and specimens of *Polystichum Lonchitis* which I have seen in the herbarium of N. B. Ward, Esq. collected on the west coast of Ireland, exhibit numerous similar annual constrictions in a very beautiful manner. This appearance, then, on the stem from Shaftesbury seems to indicate an alternation of climate similar to what we now experience in Britain, and this is further attested by the exogenous rings in the specimens of fossil wood to which I have alluded. These rings are of different thicknesses, one season having been then more favourable to the growth of the plant than another, as at the present day. It is well to remember here, however, that cold is not the only physical cause of interruption, but that a periodic dry wind as on the coast of China,



olding, delt. Hanhart, Impt.

CAULOPTERIS DICKSONIOIDES, Car. U. GREENSAND, SHAFTESBURY.



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an extreme heat without moisture as in several tropical regions, and other causes, may produce a season of rest in plants like that resulting from winter in our temperate region. The small size of the frond, indicated by the smallness of the scar, would favour the opinion that *Caulopteris punctata* inhabited a temperate region.

Corda describes four species of the genus *Caulopteris* (*Protopteris*, Corda), viz.: *C. punctata*, *C. Singeri*, *C. Cottæi*, and *C. microrrhiza*. It is possible that these are all the same species, the differences considered as of specific value by the author depending on the portion of the stem to which the specimens described belong. The fern-stem is the type of the acrogenous method of growth. This is too often held as meaning that the older part of the stem undergoes no change, the life and change being confined to the growing point. But this is not the case, for as long as the fern lives the older portion of the stem continues to elongate, and the leaf scars to separate more and more from each other, so that the base and the apex of the same stem present very different appearances. The closely packed scars of *C. punctata* indicate that the specimens on which this species is founded belong to the upper portion of the stem. *C. Singeri* and *C. Cottæi* have the same stigma on the scar as *C. punctata*, but differ from that species and from each other in the distribution of the scars on the stem: they may be founded on specimens from near the base. The scars of *C. microrrhiza* are unknown, being hidden by the mass of small roots which envelope the stem at its base.

I have adopted Goeppert's name, *Caulopteris*, because it was established prior to *Protopteris* of Presl. Independently of this, it is the best designation—the one that would be adopted if fitness were the criterion, as it indicates all that it is safe to affirm regarding the fossil, while *Protopteris*, as applied to this Greensand fern, is evidently erroneous. I add the synonymy with references to the works where they were established.

Lepidodendron punctatum, Sternberg, Flora der Vorwelt, Fasc. I., pp. 19 and 23. Tab. VI. and VIII., fig. A.; Fasc. IV., p. xii.
Filicites punctatus, Martius, De Plantis Antediluvianis, in Denkschr. Regensb. Gesellsch. Vol. II., p. 130.
Sigillaria punctata, Brongniart, Hist. Veg. Foss., Vol. I., p. 421. t. 141, fig. 1 (a copy of Sternberg's figure).
Caulopteris punctata, Goeppert, Foss. Farrnkräuter, p. 449.
Protopteris punctata, Presl in Sternberg's Flora der Vorwelt, Vol. II., p. 170. t. 65. fig. 1, 2, 3.
Protopteris Sternbergi, Corda, Beitrage Flora der Vorwelt, p. 77, t. 48, fig. 1.

EXPLANATION OF PLATE XIII.

A.—Portion of the stem of *Caulopteris punctata*, Goepp., reduced one-half. From the Greensand of Shaftesbury, Dorsetshire. B.—A single scar of same, natural size. C.—A portion of the stem of *Dicksonia antarctica*, Labill., from New Zealand.

NOTE.—The name of *Caulopteris Dicksonioides* must be considered as withdrawn, having been printed on the plate before the age of the Kaunitz deposit had been ascertained. The description in the 'Ziva' being written in Bohemian, I am indebted to Thomas Watts, Esq., and Russell Martineau, Esq. of the British Museum Library, for a translation of M. J. Krejčí's descriptions.

III. HISTORY OF THE DISCOVERY OF THE FOSSIL ELEPHANT OF MALTA, WITH A DESCRIPTION OF THE FISSURE IN WHICH IT WAS ORIGINALLY FOUND.

By A. LEITH ADAMS, M.B., F.G.S., &c.

ABOUT Midsummer of the year 1857, when a quarry was being made in the soft calcareous sandstone in the district of Gandia, near the village of Micabba, Malta, one of the numerous fissures so common in all the formations of the two islands was observed to run in a straight line about E. and W. It was a simple vent, with several funnel-shaped expansions, and, as usual, was filled with red earth and stones. Among the *débris* of one of these expansions, several bones of large size attracted the attention of the workmen, and Dr. Speteri Agius, LL.D., a gentleman residing in the neighbourhood, having heard of the discovery, repaired to the spot, and picked up from among the exuviæ a portion of a tooth and several fragments of bones, which he deposited in the Museum of the Maltese University. Shortly afterwards, a dispute between the proprietor and the lessee of the quarry put an end to the excavation, and the entire cavity was filled with rubbish, and levelled out into a field. In that condition it remained until reopened in June 1865.

Reverting to the above-mentioned remains found by Dr. Speteri Agius: these included a portion of an upper penultimate true molar of *Elephas Melitensis*, showing five disks of wear, the sixth plait fractured, and the remainder wanting; two heads of humeri; portions of shafts of a femur, humerus, and fragments of other bones.

In my memoir 'On the Maghlak Cave and other Ossiferous Deposits found in Malta,' read at a meeting of the Royal Dublin Society, November 18th, 1861, I adverted to this discovery, and stated my reasons for considering the molar distinct from that of the mammoth, to which it was then erroneously considered to belong; surmising also, at the same time, that its characters more closely approximated to those of the African Elephant, in which sub-genus (*Loxodon*) it has since been placed by the late Dr. Falconer.

Such is the history of the discovery of this remarkable proboscidian. Three years afterwards (1859), a rich collection of the teeth and other remains of this elephant were collected by Captain Spratt, R.N., from the *débris* of a cave near the village of Zebbug, and forwarded to the late Dr. Falconer. Descriptive details of the cave and its exuviæ were read by both gentlemen at the Cambridge Meeting of the British Association in 1862, when Dr. Falconer proclaimed the elephant to be a new species, and named it *Elephas Melitensis*. Further researches in caves, fissures, and alluvial deposits in Malta have resulted in disclosing many more remains of this elephant, which undoubtedly roamed (and at no very distant period) in vast herds over the area, with two species of *Hippopotamus*, a gigantic rat, birds of colossal dimensions, a lizard, and a land-turtle of an extraordinarily large size: at a time when the land-shells were identical with those now living on the island.

Having long desired to examine the spot where the first traces of the Maltese Elephant had been discovered, and after many unsuccessful attempts to overcome foolish prejudices,—by no means credit-able to the native intelligence or learning,—permission was at last obtained through the kind intervention of His Excellency Sir Henry Storks, and the clearing out of the Gandia fissure was begun on the 14th June, 1865, at the expense of the Malta University, where the fossils obtained have been deposited. I was requested to superintend the excavations, and with the able assistance of my friends, Mr. Welch, 22nd Regiment, and Dr. Carruana, LL.D., secretary and curator to the College Museum, the entire *débris* was carefully examined, and the work completed in a few days.

The Gandia fissure was found to be a funnel-shaped hollow, 15 feet deep, and about 9½ feet in length at the entrance. The average thickness might have been originally from 4 to 5 feet; but as a portion of it had been removed with one of the sides of the fissure during the quarrying in 1857. the last measurement could not be ascertained with accuracy. Tracing the rent along the surface of the rock for upwards of 200 feet, it was found to be a vertical fissure, with the opposite sides almost in close apposition, excepting at the fossiliferous gap, and others of smaller dimensions, which were seen here and there along its course. The sides of the fissure were perfectly smooth, and coated with a thin layer of stalagmite, forming polished surfaces, doubtless resulting in part from friction of the opposing sides during oscillations of level, as can be clearly seen on many of the 'slips' and 'fissures' in numerous other quarries.

After the removal of the rubbish occupying the side of the fissure, which had been taken away in quarrying, a mass of red earth and stones, 8 feet in height by 9½ feet long, and from 2½ to 3½ feet in thickness, was seen adhering to the remaining side of the fissure. The stones were all composed of the parent rock, and varied in size from a few inches to two or three feet in circumference, and were, for the most part, rounded and much decayed, from having been long in the red earth: others, however, had become hardened into a pale green limestone, by the absorption of water charged with carbonate of lime—an occurrence common to fragments of this rock that have been exposed to the slow percolation of lime-water in caves and elsewhere. Both stones and earth were firmly packed, as if by considerable pressure. From top to bottom, but perhaps more so near the former, were interspersed teeth and bones of the Maltese Elephant, indiscriminately with the bones of very large and smaller birds, and jaws, teeth, and bones of the *Myoxis Melitensis*. No shells were found. The long bones of the quadrupeds and birds were all broken and in fragments, excepting those of the feet, which were usually entire. The elephants' teeth, although fractured in many cases, showed no traces of having been rolled; and from the perfect condition of their machærides and fangs, it was evident they had not been brought from a long distance. The same was observed with reference to the articulating surfaces of the birds' bones, which as a rule were also very entire. The perfect state of disorder in which the remains were found precluded the idea that the elephants, at least, had fallen into the fissure, but proved, on the contrary, that their remains, and those of the other animals, had been swept in by the agency of water. As further exemplifying this, it is worthy of note, that, two miles distant, in a south-westerly direction, were situated two remarkable caves, and a breccia, in which I found abundant remains of *Hippopotamus*, and of *Elephas Melitensis*, in situations clearly indicating that they had been deposited by the tumultuous agency of water, which in one situation had borne down the bones of elephants along with the soil in which they were embedded. There also were birds' bones in great abundance, of the same dimensions as above; and, from the length of the shafts in many cases, I opine that water-birds predominated.

I have also reports, from intelligent native gentlemen, of many fossiliferous fissures having been discovered, chiefly in quarrying and digging foundations of houses, and that the contents were as described above, sometimes a blue clay taking the place of the red earth. The description of the remains in one or two instances clearly point to the Elephant.

From a close study of the geological features of the districts in which the Post-tertiary fossil fauna of these islands has been found—also of the deposits and organic remains,—I am strongly of opinion that large bodies of water at one time flowed over a great portion of the south-eastern half of the island of Malta, either before or during the submergence of the surrounding area. This will be more apparent when my explorations in other parts of the island come to be noticed.

I cannot, however, close this brief communication without a passing notice of the following points :—

1st. The absence of Carnivora among the Post-tertiary fossil fauna hitherto discovered in Malta, although traces of gnawing on the bones, in one cave, very clearly shows that such quadrupeds did exist.

2nd. The wonderful sameness of the fauna, and the excessive numbers of the individuals in certain situations; besides the still stranger anomaly of vast quantities of remains of *Hippopotamus* and *Elephas* occupying distinct caves, within 200 feet of each other, and almost on the same terrace-cliff. I believe, however, as further explorations proceed, the majority of these points will be cleared up; for there are not wanting indications among my late explorations, which, if followed up, may lead towards important discoveries.

I will now enumerate the fossil remains of the *Gandia Fissure.*

I. ELEPHAS MELITENSIS.

a. Teeth.	Upper Jaw.		Lower Jaw.	
(1.) Milk Molars.	R.	L.	R.	L.
1. Antepenultimate . . .	—	—	—	—
2. Penultimate	—	1	3	—
3. Last	—	2	1	—
(2.) True Molars.				
1. Antepenultimate . . .	2	—	1	—
2. Penultimate	2	3	—	—
3. Last	—	—	1*	—
Total				16

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* The last true molar was of unusual size for this elephant. I fortunately

(3.) Broken fragments and plaits equal to about six teeth, chiefly belonging to adolescent and aged individuals.

b. Tusks.

1. Fragment of a tip, $3\frac{1}{2}$ in. in length, perfectly straight; greatest circumference, $2\frac{7}{10}$ inches.
2. Portion of a curved central part of the tusk, length 6 in. by $6\frac{3}{10}$ inches in circumference.

c. Skull.

1. Fragments showing diploë.
2. Portion of right lower ramus, with tooth *in situ*, of a very young individual. The tooth is well worn, and indicates the second of the milk-series. The symphysial canal is wider in proportion than in *E. Africanus*, making the chin less pointed.
3. Mastoid processes of temporal bones of at least two adult individuals. This portion of the skull is common among the elephant remains I have found in other situations.

d. Vertebral Column.

1. One cervical vertebra.
2. Five dorsal ditto.
3. One caudal vertebra.
4. Numerous fragments of ribs.

e. Upper Extremity.

1. Two portions of scapula.
2. Four heads of humerus.
3. One inferior extremity of radius.
4. Two upper extremities of radius.
5. Seven carpal bones.
6. Eight metacarpal bones.

f. Lower Extremity.

1. Two portions of os innominatum.
2. Two inferior extremities of tibia.
3. Five tarsal bones.
4. Six metatarsal bones.

g. Thirteen phalangeal bones.
h. Three sesamoid bones.
i. Numerous fragments of long and flat bones.

II. Myoxis Melitensis.

a. Two lower jaws and teeth. *b.* One tibia.

III. Birds' Bones.

Not determined; several of large dimensions with long shafts, possibly belonging to Grallæ and Anseres of enormous size. The breadth across the lower condyles of the femur and humerus in many average respectively $1\frac{2}{10}$ inches.

N.B. This last includes also the remains found by Dr. S. Agius.

IV. On the Geology of Hobart Town.

By Thomas Harrison, Esq.

THE island of Tasmania is connected, as it were, with the continent of Australia by two chains of islands, the lines of which are afterwards continued in the mountain-systems both of Tasmania and Australia. The Tasmanian systems pass from north to south in a strangely zigzag course, throughout which the mineralogical cha-

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enabled to take its measurements before it was partially destroyed in removing the matrix. The extreme length of the crown was $8\frac{1}{10}$ inches; the length of surface in wear, $6\frac{8}{16}$ inches; number of plaits, 10, and a talon ridge; number of disks of wear, 8.

racter of the rocks varies considerably. The land, therefore, may be presumed to have once presented a very different line of contour to what it does at the present day.

In bygone geologic ages, Tasmania must have been represented by at least five rocky islets. Then the intervening sea-bottom became raised, and the area appeared as one continuous mass of land, deeply indented, however, by two gulfs, which being in time filled with aqueous deposits, now constitute the respective coal-basins of Campbell and Hobart Towns. It is to the geology of the latter basin that the following notes bear reference.

Following the road from Hobart Town to New Norfolk (a township situate on the Derwent, and about twenty miles from the metropolis), there are met with a succession of Carboniferous shales and sandstones, cut by numerous dykes and masses of eruptive greenstone and black basalt, or covered over by gravel and other aqueous deposits, until near Bridgewater (ten miles from Hobart Town), where there is exposed a dense claystone, which is in turn succeeded by thick beds of highly fossiliferous limestone. The latter, after extending for several miles, and presenting a gradually rising series, dip in quite a contrary direction, so that at New Norfolk the claystone of Bridgewater is again met with, and then, still further on, towards Hamilton, are beds of sandstone, shale, and coal, appearing in the reverse order of the succession passed over in journeying from Hobart Town to Bridgewater. It would seem, therefore, that an anticlinal axis exists near the latter place (see fig. 1).

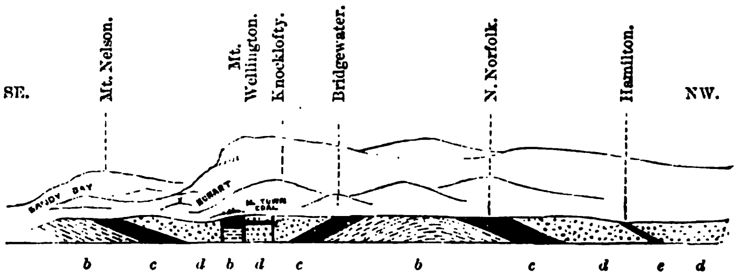

FIG. 1.—SANDY BAY *vid* HOBART TO NEW NORFOLK.*
(The whole of this section is much cut up and disturbed by dykes of basalt, &c., which are not shown.)

Along nearly all the other routes pretty much the same series of rocks is met with, only that the limestone seldom appears at the surface: in the lines leading up Mount Wellington, however, the last-named rock is met with at barely a mile from the boundary of Hobart Town. This is simply the result of great disturbance and denudation having taken place thereabout.

The area of Hobart Town is traversed by a series of broad stripes alternately of sandstone and basalt. In one locality—near Trinity

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* For an explanation of the letters, see fig. 2.

Church—the claystone appears as a surface rock; the oval patch crowning Knocklofty is a compact greenstone, resembling that of Mount Wellington.

It is worthy of remark, that nearly all the sand and claystones have a dip in the direction of Mount Wellington. This peculiarity of dip is not confined to Hobart Town alone, but seems to be general over the whole adjacent district, the only exception being upon the immediate sides of the mountain, and here the dip is directly opposite to that prevailing elsewhere.

By the accompanying section (fig. 2) it will be seen that, excluding Mount Wellington and the basalts, the arrangement of the sandstones somewhat resembles a series of ratchet teeth, rising one above the other from the Derwent towards the south-west. As a very homely illustration, we may suppose a set of wooden cubes to be laid out upon a yielding foundation, say a sofa cushion, so that the surface of the whole represents a perfectly level superficies. Some disturbing force having changed the horizontal plane of each cube into a gently sloping incline, at every joint a diminutive escarpment was formed. If we now imagine that some molten substance, such as wax, has been forced from below through the various interstices, so that the overflow partially fills up the miniature valleys, we shall have a model representation of Hobart Town, with its sandstones, dislocations, and eruptive rocks.

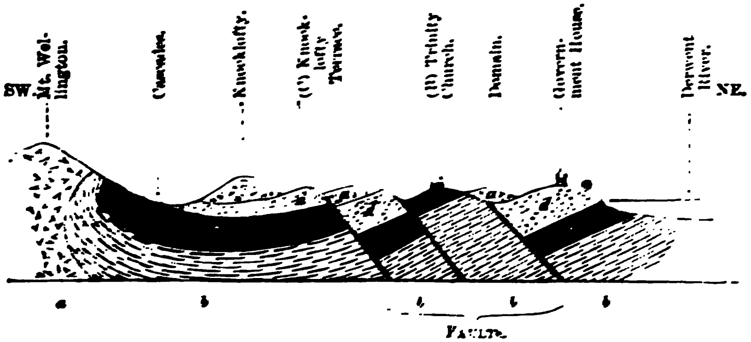

Fig. 2.—Ideal Section of Hobart from Mount Wellington to Derwent River.
a. Basalt and Greenstone. b. Limestone. c. Claystone.
d. Sandstone. e. Coal-beds.

* Indicates the spot where the femur of Labyrinthodon was discovered.

It will probably be asked why the dip of the various beds remains so constantly the same, and towards instead of from an evidently upheaved rock? Perhaps the local dip in the opposite direction, mentioned as occurring on the sides of Mount Wellington, may, in some measure, explain the difficulty.

If a vast level plateau, such as once existed hereabouts, should ever become broken up by the protrusion of a 'massif' like the Mount Wellington range, it is not unreasonable to suppose that many fractures would take place at a distance *from*, and perhaps parallel *to*, the intrusive mass. In addition to this simple fracture of the beds, a lateral pressure may also have led to a phenomenon somewhat analogous to what takes place when the pieces of ice in a large floe begin to pack one upon the other. Hence the apparent anomaly just alluded to.

From whatever cause these secondary fissures arose, they do not seem to have been filled up with the basalt which they now contain contemporaneously with their formation. Still, the time elapsing between the fracturing and eruptive forces may have been extremely short; what is meant being, simply, that the fissures referred to do not owe their origin to the protrusion of the basaltic dykes by which they are now completely occupied.

Of the rocks met with in the district, the lowest is of an extremely fossiliferous character, and is called by the colonists Mountain or Carboniferous Limestone (?). It appears to be divided into two distinct beds. The lower contains much lime and a profusion of bivalves (*Spirifera*, *Pectinidæ*, and *Producta*), and the upper being more arenaceous, and inclosing a large quantity of corals (*Fenestella* and *Stenopora*).

On the sides of Mount Wellington are a number of erratic blocks, containing a larger number of spiral univalves. Such blocks are of great hardness, and seem in some instances to be nearly made up of arenaceous particles; but it must not be supposed that this variety in organisms and texture indicates a formation upon a horizon different from that of the adjacent limestone.

Above these beds is a dense compact stratum, locally known as 'mud' or 'clay stone.' According to Mr. Selwyn, it is upwards of 400 feet in thickness. In a few places impressions of shells are discoverable; but generally fossils are of rare occurrence. Scattered here and there throughout the mass are numerous pieces of quartz and other rocks.

It was probably the prevalence of vast quantities of turbid water, originating this deposit, which so completely destroyed the immense growth of corals characteristic of the upper beds of limestone.

Immediately over the 'clay-rock' is superimposed a great thickness of sandstone. This stratum, also, is especially barren of any remains of animal life; but sandstone generally forms a bad matrix for the preservation of fossils.

Interstratified with the upper portion of the sandstone beds are layers of shale bearing impressions of 'fern-leaves' and 'calamites,' together with one or two layers of coal, changed, for the most part, into anthracite. The absence of *Sigillaria*, *Stigmaria*,* *Lepidodendron*, and other genera characteristic of the English Coal-measures, would seem to suggest that the coal of Tasmania, like that of Victoria, is not of the true Carboniferous period.

What may, in some measure, go to confirm the opinion so hazarded, is the discovery in the sandstone of a bone, said by Professor Owen to be the 'femur of a Labyrinthodon,'—a reptile, if I mistake not, generally associated with rocks of the Triassic age.

A Hobart Town geologist, Mr. Morton Alport, speaking to me upon the subject, stated his belief that the bone in question was found in beds situated above the coal. It is with extreme diffidence that I venture on a conclusion contrary to that of a gentleman whom I believe to be both an enthusiastic and a careful observer; but, from a rather rapid examination of the beds in question, I had certainly thought differently. The section (fig. 2, p. 493) will show both the position of the fossil, and also the nature of the rocks adjacent.

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* See Note at the end.

It will be seen that, from the western boundary of the stripe of basalt occupying the 'Domain,' to the sandstone of 'Knocklofty Terrace,' the strata present a gradually ascending series of outcrops; although it is more than probable that, in consequence of faults, the sum of the outcrops is not exactly an expression of the real thickness of the series exposed.

At the point B (Trinity Church) beds very low in the succession appear on the surface, the upper ones having evidently been denuded. As the coal-seams appear to lie near the top of the series, it is plain that a comparatively small amount of denudation would remove both such seams, and also a portion of the immediately underlying sandstone. The position of the beds wherein the fossil was discovered, close to the Government House, near the centre of the valley of the Derwent, would seem to give no promise of being spared the influence of denuding agencies; so that although through faults, the points B (Trinity Church) and C (Knocklofty Terrace) are evidently more upheaved and denuded than the ground near Government House, it is hardly probable but that some strata were cut off from the latter locality also; and as I believe no coal-beds have been discovered thereabouts, it seems but reasonable to suppose that the carbonaceous strata have been swept away, and that the beds now remaining, although of newer age than the claystone of Trinity Church, are decidedly of older age than the coal.* This would make the fossil referred to of great use in determining the geological position of the Tasmanian beds, and show that they were deposited, at the very least, during the existence of the Batrachian forms of the Secondary period.

It may be asked, as the limestone is of Palæozoic, and the coal of Mesozoic age, whether the surface was unsubmerged during the intervening time, or whether there has been a subsequent removal of rocks once deposited?

Perhaps it will appear that neither of these alternatives is absolutely required. The Permian group may, after all, be represented by a portion of the strata intervening between the two formations, although, through the absence of fossils, evidence of such fact is nowhere discernible. The Magnesian Limestone may have been so far local as to be excluded altogether from Tasmanian waters. Probably the beds, during the course of their deposition, resembled not a little the accumulations of sand now gathering upon the coasts both of Tasmania and Australia; deposits which, it is likely, will be entirely barren of fossils. Such beds would necessarily present but few evidences of changes going on elsewhere, or even in their immediate neighbourhood.

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* I have dwelt particularly upon the above facts, since they appear to [illegible] especially upon the question of the age of the Australian coal-deposits.

In speaking of the section passed over between Hobart Town and New Norfolk, mention has been made of certain recent aqueous deposits. Among these the most remarkable feature is the enormous amount of pebbles accumulated in many places. Such pebbles are of every size, from that of coarse grains of sand to boulders measuring many feet in circumference. They are composed of a variety of materials—quartz, granite, sandstones and limestones, basalt, diorite, and, in a few instances, what I judged to be fragments of Silurian slates. The whole of these are waterworn to a great extent. In some places an accumulation of pebbles only occupies the whole of an exposed section; but in many cases the pebbly deposit rests upon or is interstratified with loam, clay, or sand.

One or two local geologists suggested whether the pebble-bed might not be due to the former existence of glaciers. The more likely cause, however, would seem to be one involving tidal action. The Derwent, as may be seen on the map, is of very different width at different parts of its course; in some places it contracts into a narrow channel, and in others expands into a wide lake-like basin. As may be supposed, this conformation, by the expansions acting as reservoirs receiving and giving out the tidal wave, is productive of currents, running with great rapidity, quite sufficient to hurl onwards masses of stone as large as those spoken of. It is probable, too, that as the land gradually emerged from the sea, these irregularities in width may have been still more disproportionate than they are at present; or, on the other hand, such disproportion might, for a time, have disappeared altogether, as various heights above the sea were attained or exceeded. Hence we seem to have an ample explanation of the clay and sandy beds interstratified with what may be called the boulder-deposit.

Scattered at intervals over much of the district near Hobart Town, are numerous beds of shells differing but little, if anything, from those still found in the adjacent seas. Some of these beds are met with at the height of many feet above the highest tides. Similar beds are seen in many places round the shores of Port Phillip Bay, and are supposed to indicate that a progressive elevation of the land has taken place at no very distant period, even if such elevation is not still going on.

Igneous rocks, as may be supposed from what has been already said, have played no unimportant part in developing the beauties of Tasmanian scenery. These consist principally of basalt and greenstone, forming mountain-ranges, capping the tops of hills, or protruding, as dykes, from the clefts of sand or limestone. Owing to the unequal wearing of the two rocks, the igneous and the sandstone, as much as to the tremendous disruptions, in some measure connected with outbursts of the former, Tasmania appears as a thickly-wooded Caledonia; and Hobart Town reminds the Scotchman not a little of his much but not too greatly lauded Edinburgh. True, there is no Castle Rock; but Knocklofty, 1,700 feet in height, forms no bad substitute for the Calton Hill, and Mount Wellington far exceeds Arthur's Seat in altitude and grandeur. The greenstones, too, on the top of the latter are strikingly columnar, rising above the densely timbered base in a colonnade of Titanic pilasters —a gigantic Staffa superimposed on an exaggerated Mount Edgecombe.

Along the shores of Storm Bay, igneous rocks are developed in cliffs of the most romantic form. Where a columnar structure prevails, many separate masses may be traced from the top downwards for many hundred feet; and so regular is the line that bounds these tremendous crystals, that a stranger could easily mistake a group of them for baulks of timber set on end. Those who are acquainted with the features of New Zealand military architecture will understand me when I say that Cape Rauol—one of these basaltic headlands—may be aptly compared to a tremendous 'pah' erected by a race of giants, and subsequently battered by some colossal artillery. 'Cape Pillar,' farther down the bay, is alike, or even more, romantically shaped. The base is worn into chasms, or fretted with caves, that might—so regular is the outline—be Gothic doorways leading to what would almost seem some towering castle keep above.

These basaltic outflows have also tended to modify denuding influences brought to bear upon the somewhat friable sandstone which such outflows often surmount as a thin capping. This is especially seen along portions of the eastern coast, much of the cliff-line of which is composed of what may be termed two stories—sandstone below, and black amorphous basalt above.

At Schouter's Island, near Oyster Bay, the conservative power of igneous rocks is strikingly displayed. Northernly, this island is of granite. Against the granite, sandstone and layers of coal have been deposited. Then has come a period of convulsion, breaking up the sandstone-plateau and dislocating the beds. Currents sweeping over what was still a sea-bottom have washed away much, both of coal and sandstone; but, in one spot, an outlier of the latter containing seams of the former was left undenuded until an eruption of greenstone covered the district, and preserved this isolated mass from the effect of any subsequent ocean-currents. It is simply the story of flies in amber, or the preservation of the bones of Bruce in melted bitumen, illustrated on a large scale. And so here coal is dug from a seam which but for such agencies must have been swept away by ceaseless ocean-surges rolling uninterruptedly from the far-off Southern Pole.

NOTE.—In 'A Sketch of the Principal Geological Features of Hobart, Tasmania, by S. H. Wintle, Esq.,' in the 'Quarterly Journal of the Geological Society' for November last, '*Stigmariæ* are mentioned as having been met with in the New Town Sandstone. With all due deference to the opinion of Mr. Wintle, a resident on the spot, I can but think the above statement is an error. Whilst in Hobart last winter, I especially made enquiries respecting any true

Coal-measure fossils which might have been met with; but the only fossils shown me or spoken of were ferns, and what are called calamites. There seems among Hobarton geologists a strong desire to have their coal-deposits ranked with the English coal-measures; and any person venturing a statement to the contrary is looked upon with disfavour. Yet, notwithstanding this feeling, I could hear no hint whatever that either *Stigmaria* or *Sigillaria* had ever for certainty been found in any of either the shale or the sandstone beds. Mr. Wintle's *Stigmaria* was probably the stem of some tree-fern, which is a very common fossil in the Tasmanian coal-deposits. If I am not greatly mistaken, Mr. W. admitted as much to myself in a conversation which took place after the paper referred to was posted for England. Of this, however, I am by no means certain.—T. H.

V. NOTES ON CHARNWOOD FOREST.

By D. MACKINTOSH, F.G.S.

IN the midst of a comparatively tame and highly cultivated plain of New Red Sandstone near the centre of England, there rises up a part of the under crust of the earth which presents so much the appearance of an island as to lead the imagination at once to those remote ages when its Porphyritic Peaks and Syenitic Knolls were surrounded by the sea. The geological history of this celebrated spot has been skilfully unravelled by Professors Sedgwick and Jukes (Article in Potter's Charnwood Forest); the Rev. W. H. Coleman (Article in White's Directory); Mr. Edward Hull (Memoirs of Geol. Survey); and others. It has lately been invested with additional interest by the announcement of the opinion that it is one of the 'uncovered areas' or wrecks of the Laurentian or pre-Cambrian continents, which Dr. H.B. Holl[*] and others suppose may have extended or may still extend underground, from Scandinavia to Charnwood, from Charnwood to the Malvern Hills, and from the latter to North America. The late Mr. Coleman founded his opinion of their pre-Cambrian age on the absence or extreme paucity of organic remains.[†] But Dr. Bigsby has well shown that this characteristic would rather favour the idea of a formation being posterior to the Laurentian (Quart. Journ. Geol. Soc., vol. xix. No. 73); and whatever may be the age of the *Syenitic* Knolls or Bosses of Charnwood Forest, the stratigraphical dissimilarity of its slates and porphyries from the Laurentian formation of America, and their resemblance to the Cambrian rocks of North Wales, ought to make us cautious in assigning to them a very remote antiquity. In many respects there is not perhaps in England a district more puzzling to the geologist than Charnwood Forest; but all agree with Professor Sedgwick in believing its general conformation to have arisen from an anticlinal elevation by which its stratified masses were divided so as to cause those on one side to dip to the NE. and those on the other to the SW. Some have supposed that the upcast to the south-west was very much greater than in the opposite direction.

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[*] Quart. Journ. Geol. Soc., vol. xxi. No. 81, p. 72.

[†] Apparent traces or impressions of vegetable or animal life have been discovered in the Southland slate-quarries on the eastern side of the Forest.

Syenitic Knolls.—A line of knolls or patches—in some places syenite, in others greenstone—stretches at intervals from New Cliff and Long Cliff, by Benscliff, towards Bradgate, which Mr. Coleman believed to run roughly parallel to the anticlinal line of the forest.* But the principal Syenitic bosses are Mount Sorrel to the east, and Markfield Knoll, Cliff Hill, and Stanton Fields to the south-west. Syenite may likewise be seen at Hammercliff and Birchwood Plantations, at Bardon Castle, Groby, &c. Some have supposed that these syenitic bosses are remaining portions of a great mass or masses erupted previously to the deposition of the slates, which, so far as yet observed, lie apparently *undisturbed* in their immediate neighbourhood;† others believe that the syenites were erupted contemporaneously with the slates and porphyries of which the Forest district is principally composed. Do these syenites mark the craters or centres of eruption from which beds of lava overflowed?—these beds at first assuming a syenitic structure, and at a greater distance becoming porphyry? and can the origin of the porphyritic beds of Charnwood Forest be in this way explained?‡ Or does the great difference in lithological structure between the syenites and porphyries preclude this supposition? At Hammercliff, Mr. Jukes observed an apparent transition from syenite to porphyry—the summit and probable nucleus of the hill being syenite, with a surrounding porphyritic mantle. But might not these phenomena be regarded as equally indicative of the syenite having been thrown up since the formation of the porphyry so as to elevate the latter all around it, and at the same time obliterate the line of junction by metamorphism? Bardon Hill, to the west of Hammercliff, appears to be greenstone at the top, with a porphyritic structure lower down, which Mr. Hull regards as a passage between the greenstone and the porphyritic ridges to the north—the two having been separated by a fault. But might not this fact be likewise regarded as a proof that Bardon Hill was elevated after the formation of the porphyry? In the neighbourhood of Bardon Hill, and resting unconformably on the Coal-measures, is a sheet of greenstone quite distinct from porphyry in its composition, and in many places differing but little from compact basalt; specimens of it may be seen near the office of the Whitwick Collieries.§

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* Had these igneous rocks anything to do with the anticlinal upthrow, which Mr. Hull and others believe to have occurred at the close of the Carboniferous period, or are they of much older date?

† Too much importance cannot be attached to the examination of fresh excavations in the quarries of Markfield Knoll, Groby, &c., in order to discover, if possible, the actual contact of the igneous and sedimentary rocks.

‡ See Prof. Ramsay on North Wales, in the first volume of 'The Geologist.'

§ In one of the neighbouring Snibston pits it was found to be 21 feet in thickness. In two of the Whitwick shafts its thickness is 63 feet.

Can this flow of trap be traced to Bardon Hill ? or (according to a local geologist) to a greenstone-rock near Whitwick ? or to neither ?

Porphyritic Rocks.—These rocks may be seen exposed at intervals along the irregular ridge extending from Grâce-Dieu to Green Hill. The rocky projections called High Cademan, High Sharpley, Rachet Hill, Pedlar or Peldar Tor, High Towers [Tors ?], Timberwood Rocks, Flatfield Rocks, the Hanging Stones, &c. are more or less composed of porphyry ; these tors, taken as a whole, present a wonderfully uniform porphyritic structure, as may be seen in the stones of which the roadside walls near Whitwick have been built. But as the geologist proceeds with his hammer to examine the rocks of the different tors he now and then finds unexpected variations in their composition, graduating from felspar, and compact felspathic porphyry, through the ordinary varieties, to porphyritic and compact greenstone. He may in some places see the porphyry covered or underlain by what Mr. Hull calls 'slaty ash.' That gentleman has observed a bed of altered slate in the interior of the Forest, apparently dipping under the porphyry. This would seem to indicate that the overlying bed or beds of porphyry must have flowed over the slate from a submarine volcanic vent. On ascending from the Hanging Stones to the High Towers, I have noticed some striking variations in the composition of the rocks. At the Hanging Stones, a brecciated structure is combined with a porphyritic. At a high level, between Mr. Green's house and the lodge, the rock is a very coarse breccia, which, if not directly volcanic, must have been highly metamorphosed ; higher up the structure becomes more decidedly porphyritic. On this acclivity groups of rocks, reminding one of what may often be seen on sea-coasts, may be traced at different levels, with intervening flat areas which may have been sea-beaches during the last emergence of the Forest district.

On the side of the foot-path leading from the Reformatory road towards Green Hill, I noticed a block of porphyry enclosing a fragment of fine slate, with the boundary line between the two very distinctly marked. Many similar instances have been discovered ; and how far these included fragments furnish evidence of the porphyry of the district having once been in a molten state, is a very important inquiry in the present state of geological speculation. Mr. Coleman, an advocate for the metamorphic origin of the Charnwood porphyries, admitted that there must have been fusion at those places where the slaty fragments were caught up ; but why, it may be asked, have recourse to this explanation in the case of particular phenomena, and deny the volcanic origin of the rocks in general ? The advocate of metamorphism might reply that the doctrine of 'easier fusibility' is implied in the very fact of unaltered or little altered fragments of slate occurring in the porphyry ; and that the latter therefore, generally speaking, may be of metamorphic origin, though in parts it may have been 'heated to the melting point.' In this district the respective claims of the rival theories—metamorphism and igneous fusion—may be studied within a very limited area. The observer ought previously to be well acquainted with the results of the experiments of Delesse and Daubrée * and the discoveries and opinions of Sedgwick, Ramsay, and Murchison, concerning the origin of the porphyritic rocks of North Wales and the Lake District.

NOTICES OF BRITISH AND FOREIGN MEMOIRS.

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I. DER HANNOVERSCHE JURA. By KARL VON SEEBACH. Berlin, 1864. 4to. 158 pp.

THIS work is a very useful and very valuable addition to the previous memoirs illustrative of the geology and fossils of North Germany, by Roemer, Strombeck, Credner, Wagner, Schlonbach, &c., as also to those of Oppel and Quenstedt. It is divided into two parts, Geological and Palæontological, comprising 158 pages of letterpress, a geological map, and 10 plates of fossils. The first part contains a sketch of the geographical distribution of the Jura formation in North-west Germany, a description of the various strata, and some general remarks on the whole group. The lowest bed, which is but briefly noticed, is the zone with *Avicula contorta.* The Jurassic beds are described under three sections—the Lias, Dogger, and Upper Jura; each of these again subdivided into certain zones or strata, somewhat similar to those usually adopted by geologists for the Oolitic group. The Lias comprises nine of these zones, of which four belong to the lower, three to the middle, and two to the Upper divisions. The Dogger contains six, and the Upper Jura nine.

Dr. Seebach's subdivisions, and his lists of characteristic fossils, will doubtless be found useful for comparison with those of the British area. Dr. Seebach himself is inclined to consider that the Lower Jura formation of Hanover, up to the Cornbrash, resembles that of South Germany, whilst the Baltic Jurassic strata present a greater similiarity to the French and English types.

The second or Palæontological part contains a table of 373 species, zoologically classified, and showing at the same time their geological distribution. This is followed by a description of the new species named by the author, and critical remarks upon species previously described; the whole forming a useful contribution to the palæontology of the Jurassic formations.—J. M.

II. SKETCH OF THE GEOLOGICAL STRUCTURE OF THE SOUTH STAFFORDSHIRE COAL-FIELD. BY J. BEETE JUKES, M.A., F.R.S., &c. (Prepared at the request of the South Staffordshire Local Committee, for the use of Members of the British Association, at the Birmingham Meeting, 1865.) Birmingham, 8vo., pp. 20.

WE reprint the following extract from Professor J. Beete Juke's pamphlet on the Position and Lie of the Rocks in the South Staffordshire Coalfield.

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* Also, Observations on the Structure of Mount Sorrel Syenite, by H. C. Sorby, F.R.S., noticed at p. 448 of GEOLOGICAL MAGAZINE for October.

'The Coalfield is an island of Palæozoic rocks surrounded by the Triassic beds.

'The line of the Palæozoic rocks may be sketched as follows:—An anticlinal ridge, complicated by three local irregular dome-shaped elevations, runs from Dudley for four miles to the NNW. The three dome-shaped elevations, the most northern of which has an elevated synclinal trough attached to it on the west, bring up to the present surface the Silurian floor on which the Coal-measures rest, and this floor rises again to the surface on the east about Walsall, but at a much more gentle angle than on the anticlinal ridge. Between these two Silurian exposures the Coal-measures lie in a shallow basin tilted up a little to the north, so that the beds below the Thick Coal crop to the surface between Wolverhampton and Walsall. They are, however, soon thrown in again by the great Bentley fault, which is a down-throw to the north of 120 yards, and north of which dislocation they have no longer a basin-shaped form, but dip gently but steadily to the west, so that the higher beds (representing the Thick coal) come in about Wyrley, and the lower beds crop out about the Brown Hills. North of that the Coal-measures seem to retain pretty much the same lie up to Brereton.

'South of Bilston the beds dip gently to the south, and are also thrown down to the south by a succession of faults which range east and west across the basin till we come as far south as Tipton. On the east they crop gently towards the Walsall Silurian district, but are sharply bent up into a nearly vertical position on the flanks of the dome-shaped Silurian elevations as they crop to the anticlinal on the west.

'Round the southern and south-western margin of this anticlinal the Coal-measures lie at a more gentle angle, dipping everywhere towards the south and south-west, in which direction they are also thrown down by a long fault, called 'the Russell's Hall fault,' which runs from north-west to south-east, parallel to the direction of the anticlinal ridge, but extending much farther to the south-east.

'At right angles to this direction, from the southern termination of the anticlinal ridge, in the town of Dudley, a pair of faults forming the Dudley Port trough run to the north-east for about three miles; and it is remarkable that the faults on the south-east side of that trough run mostly north-east and south-west, and are down-throws to the north-west, while to the northward of the Dudley Port trough the faults run chiefly east and west, and are down-throws to the south.

'The high ground to the south-east of Dudley, capped by the Rowley basalt, continues in the same line as the high ground of the anticlinal on the north-west of Dudley. The tilting and disturbance of the beds, however, is not apparent south-east of Dudley, except by the continuation of the Russell's Hall fault, since the Coal-measures seem to be nearly horizontal under the Basalt, and in all the district to the south of Oldbury, as far as the Birmingham and Hales Owen road at all events, and as far as is known to the south of that up to the Permian boundary.

'The portion of the Coalfield which lies between Dudley and Stourbridge is divided into two irregular basins by the Netherton anticlinal, which runs north-east and south-west for about three miles from Netherton to the Lye Waste. The Thick and other coals crop round this local elevation in continuous lines. The outcrops of the Thick coal are about a quarter of a mile apart in the central portion of the ridge.

'A mass of Basalt shows itself on the axis of this anticlinal a little south of Netherton, but has obviously had no more effect in disturbing the beds there than in other places. The greatest disturbance has been produced at the Lye Waste,* where some of the Ludlow rock, with its included limestone, shows itself at the present surface, and the Thick coal just east of it was tilted into a vertical or even an inverted position.

'From Netherton and Brierley Hill and the Old Park the Coal-measures dip gently towards the west till they are cut off by the Kingswinford boundary fault. From Dudley Wood and Cradley they appear to dip regularly but gently towards the south till they are covered by the Permian beds which form the high ground of the Clent Hills and Frankley Beeches.

'Thus the southern end of the coalfield seems to be covered by the Permian beds, resting in apparent (but only apparent) conformity† on the Coal-measures; while the northern end seems to be covered unconformably by the Triassic beds. On the east and west the coalfield is bounded by long down-throw faults, which bring in the Permian and Triassic beds variously against the Coal-measures. Other faults have been traced in these beds themselves, in the country both east and west of the coalfield.

'It is probable that many of these faults may have originated at different periods, and almost certain that in none of them has the whole amount of throw been produced at once. They are the result of slow creeping movements in the rocks at the different periods when the district has been affected by those disturbing influences, of which we see the external symptoms at the present day in the occurrence of earthquakes.'

REVIEWS.

I. ON THE OCCURRENCE OF STONE IMPLEMENTS IN LATERITIC FORMATIONS IN VARIOUS PARTS OF MADRAS AND NORTH ARCOT DISTRICTS. By R. BRUCE FOOTE, Geological Survey of India. 8vo. Madras, 1865; pp. 42, 29 plates.

A LARGE series of stone implements, collected by Mr. Foote, Dr. Oldham, Mr. King, Dr. Cornish, Mr. Fraser, and Mr. W. R. Robinson, at forty-seven places in the districts above indicated, and illustrated by 29 plates in Mr. Foote's Memoir, bear a most striking resemblance to the well-known archaic flint implements of the valleys of the Somme, Seine, Thames, Ouze, Lark, &c., in France and England. The long 'cat-tongue,' the subovate and leaf-like, the oval, and other shapes, being present among the large forms, as well as the broad-edged hatchet-like specimens, besides flakes, and an 'arrow-head.' But these Indian implements have been formed out of the native quartzite, which breaks up with the same kind of fracture as flint, but with a somewhat different grain. Imbedded in the old undisturbed lateritic ferruginous alluvium ('alluvial lateritic drift,' not to be confounded with the much younger fluviatile alluvium), these stone implements tell of a past race of men frequenting what was then a shallow sea, in which the present hills were islands, and fashioning the siliceous rocks of the country into tools and arms by a precisely similar process, and in precisely similar shapes, to those adopted by the old flint-folk of Western Europe. As the valleys of France and England have been cut down some ninety feet since our archaic implements were mingled with the loam and gravel, so the lateritic gravels of Madras and Arcot have, in Mr. Foote's opinion, risen up bodily, and been grooved and channeled by the existing water-courses since the quartz-workers left and lost their tools on the shores and shoals of the 'laterite-sea.'

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* A good section across this part of the anticlinal, showing the outcrop of the lower coals, was exhibited in the cutting of the Birmingham and Stourbridge railroad just north of this place.

† The proper definition of unconformability is 'The upper group of beds resting on an eroded surface of the lower group.'

As in Europe, so in India, some of the implements are as perfect as when freshly made, and some much worn by drifting. Many interesting points of detail and of hypothesis are treated of in Mr. Foote's memoir, which is evidently the result of careful and conscientious work worthy of, and likely to command, serious attention among those interested in geologic traces of mankind.

II. THE GEOLOGY OF THE BERKS AND HANTS EXTENSION AND MARLBOROUGH RAILWAYS. By J. CODRINGTON, F.G.S. (From the Magazine of the Wiltshire Archæol. and Nat. Hist. Soc., 1865, pp. 27.)

A RAILWAY-CUTTING, with the sides carefully sloped and well turfed over, is one of the most unpleasant of sights to the eye of the field-geologist, and the more so when he is unable to find any account of the section which that cutting once showed. Why do not our Field-clubs and Provincial Natural History Societies look after these things? Would not the recording of such local facts be as fit work for their members as the propounding of theories, often crude and baseless? It is too much to expect engineers to keep geological notes of their work; and our thanks are due, therefore, all the more to the engineer who has written the paper before us,—not the first of the sort from his pen.

The cuttings of the Berks and Hants Extension Railway, which runs through the well-known Vale of Pewsey, are in valley-gravels, other surface-deposits, Chalk, and Upper Greensand. A good junction-section of the latter two was shown near Stert, of part of which Mr. Codrington gives a figure. His description, however, might well have been fuller, as he does not give the composition of the 'Chloritic Marl,' or the 'Upper Greensand'; nor does he tell us whether he classes the former with the latter, or with the Chalk. Another cutting, at Tinkfield, showed a mass of drifted Greensand, just like the same in place, but overlying peat, which in its turn was underlain by chalky mud, the whole filling a hollow in the Upper Greensand. A list of Upper Greensand fossils, showing the species found in six different places, ends the account of this railway.

The Marlborough Railway is a branch or offshoot of the above, and its cuttings are in Chalk, capped sometimes by some of the surface-beds peculiar to that rock. The first, at Lye Lane, is 'through part of the Lower Chalk, here consisting of hard, thick-bedded stone,' with fossils. May not this be the representative of the Totternhoe stone and marl (Chalk-marl) of Buckinghamshire and Bedfordshire,* and of the Grey Chalk between Dover and Folkestone?

The Lye Hill cutting is in higher beds, and shows the junction of the Lower and Upper Chalk, here marked by the presence of the 'Chalk-rock,' a hard bed, 10 feet thick, very constant in its occurrence, and, from its greenish-yellow colour, easily recognised, and which has been traced by the Geological Survey from this district for many miles north-eastward. Mr. Codrington says that 'about four feet below the Chalk-rock there is here a succession of irregularly-shaped cavities, filled with a brown sand, probably of Tertiary age, which has found its way through the Chalk-rock from its outcrop on the surface, and not through it in sand-pipes'; and he thence infers that 'the Chalk here appeared to have suffered considerable tilting-up and denudation before the deposition of the Tertiary beds; otherwise sand of the latter age could hardly have penetrated into the Lower Chalk.' With this we cannot agree. In the first place, what is the proof that the sand belongs to the Reading Beds, which in this district overlie the Chalk? and if so, what is the proof that it has not found its way down through pipes, the higher parts of which no longer exist, but have been destroyed by denudation? and we know that such remains of pipes do occur. The notion of such an erosion of the Chalk, before the deposition of the old Tertiary beds, is at variance with all that we know of the junction of those formations in England, and is quite opposed to the fact that in this very neighbourhood, as elsewhere, the Tertiary beds and the Chalk are alike affected by the same disturbances.

In the cutting, in the Chalk-with-flints, there is mostly at the top 'a drift of re-arranged Tertiary beds,' as Mr. Prestwich has noted in one of his well-known papers. 'This drift is principally the deposit called "Clay-with-flints" by the Geological Surveyors, and is covered in places by clayey sand or Brickearth.' Mr. Codrington's descriptions and figures of these beds agree with what has been published about them by the Geological Survey. The surface of the Chalk is most irregular; next to it there is a thin layer of black clay, and the lowermost flints in the clay are often black-coated; the Clay-with-flints underlies the Brickearth, and the latter often contains 'Sarsen stones,' or, as they are more generally called, 'Greywethers.' Mr. Codrington observes that the appearances of these pipes are just such as would be caused by the gradual dissolving away of the Chalk. In one case, where a tabular bed of flint was cut through by a pipe, 'the fragments extended quite across the pothole, lying in a festoon in the clay within a few inches of the bottom'; and he says that 'everything seems to indicate a quiet subsidence of the overlying bed into irregularities in the dissolving chalk. Everything here also favours the supposition that the origin of the Clay-with-flints is to be ascribed to the gradual dissolving away of the Chalk-with-flints, under a capping of drift Brickearth.' Mr. Codrington has therefore come, independently, to the same conclusion on the formation of Clay-with-flints as the Geological Survey has done. The remark that 'a covering of drift, made up of Tertiary materials (Brickearth ?), seems greatly to promote the formation of potholes and the irregular erosion of the Chalk; Tertiary beds, unless where they thin out, appear to protect it,' is to the point, as also that a 'vast time must be allowed for the formation of Clay-with-flints.'

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* See GEOLOGICAL MAGAZINE for May, 1865, p. 215.

Our author speaks of some drift older than the Boulder-clay; but we do not remember having heard of any of the latter in this neighbourhood, except in some geological remarks published in a 'Flora of Marlborough' a few years ago, in which (besides other mistakes) the mottled Brickearth (or the Clay-with-flints), so common on the Chalk hills near that town, was so called.

Mr. Codrington ends his paper with a theory of the denudation of the Vale of Pewsey, in which we must disagree with him. How the escarpments there could have been formed by the action of the sea passes our understanding. To treat of this question here would take up far too much space; but we would ask—where is the beach that should be found at the foot of the sea-cliffs ? or where is the talus that should be formed by the mouldering away of the nearly vertical cliff to the curved escarpment? Moreover, to speak more generally, can any one give an instance of a sea-cliff that runs along the strike of a formation for scores of miles, as the chalk-escarpment does round the London Basin ? Surely some such long slow agency as that which Mr. Codrington allows to be able to dissolve away vast masses of Chalk-with-flints, forming therefrom the Clay-with-flints, over a wide-spreading tract of country, would also be able to dissolve away the lower beds of the Chalk into the form of an escarpment. It is but fair to say that Mr. Codrington allows that atmospheric agencies may have had something to do with the wearing out of valleys in the Chalk, and that, knowing well that the gravels of the Vale of Pewsey are river-gravels, he also allows that it has been deepened by river-action; though he supposes an oscillation of the land to account for the different heights of some of the gravels above the river level, rather than look on them as simply the effect of the irregular wearing action of the river.

We wish that such records of facts soon hidden from geological eyes were more common, and we hope that Mr. Codrington will go on as he has done, and will not let any railway on which he may be engaged be without an account of its geology.

III. TRANSACTIONS OF THE GEOLOGICAL SOCIETY OF GLASGOW.
Vol. ii. Part I. pp. 98. 8vo. 1865. 2 Plates.)

WE have in this volume the papers read before the Society, and the proceedings from October 1864 to October 1865; and that they form a very useful series of observations and remarks, the readers of the GEOLOGICAL MAGAZINE well know, from the reports regularly given therein of the work of the Glasgow geologists. This part of the transactions (which would have been all the better for a Table of Contents) contains Mr. Geikie's Lecture on the Origin of the present Scenery of Scotland, in full; also Dr. A. T. Machattie's Lecture on Metamorphism, with special reference to chemical changes in rocks—both of great value to students, to whom also Mr. J. Sutherland's paper on Quartz, and especially Mr. J. W. Young's memoir on the presence of Magnesia in rocks, will be highly useful. Local geology is elucidated by Dr. Bryce's paper on certain Trap-rocks near Glasgow, and on the Earthquake-district of Perth; Mr. J. Dougall's, on ancient Sea-margins near Glasgow; Mr. John Young's, on certain Old Red and Carboniferous Sandstones; Mr. R. W. Skipsey's, on some Igneous Rocks of the Cathkin Hills, and on Lower Carboniferous Fossils in the Coal-measures; the Rev. H. W. Crosskey's, on Glacial Deposits of the Clyde district; and Mr. J. Thomson's, on the Geology of the Campbeltown district.

Palæontology is advanced by the determination of some new fossils from the Carboniferous rocks of Scotland, namely, *Chiton humilis*, Kirkby (pl. 1, fig. 1); *Chitonellus Youngianus*, Kirkby (pl. 1, fig. 2); *Cypricardia acuticarinata*, Armstrong (pl. 1, fig. 3); *C. crebricostata*, Armstrong (pl. 1, fig. 4); *Estheria punctatella*, Jones (pl. 1, fig. 5); *Nautilus nodiferus*, Armstrong (pl. 1, figs. 6, 7); *Pleurotomaria Youngiana*, Armstrong (pl. 1, fig. 8); and *Lingula Thomsonii*, Davidson (pl. 2, fig. 3). Notices of the finding places of these and other fossils, by Messrs. Young, Thomson, Armstrong, Armour, Skipsey, Hunter, and others, as well as some short miscellaneous papers, complete the highly satisfactory account of the last year's researches in geology, mineralogy, and palæontology by the active members of the Geological Society of Glasgow. Well may their President (the Rev. H. Crosskey) tell them, in his address, that their work gives great promise for the future of their society, and we fully agree with his closing remarks, "There are great problems awaiting study, in localities accessible to us all. The treasures of our science can be increased by all who labour honestly, in a simple and unaffected spirit, with clear eye observing what is, and a steady mind never asserting itself against the observed fact. It is our privilege to cultivate the true scientific spirit, the spirit of courage mindedness and of simple-heartedness. A scientific society should form a kind of brotherhood, each aiding the other; no member desiring his own honour at the expense of others, but willing to share such knowledge as he can gain, and to aid as to be aided. The reward is sure. The reward of all faithful, scientific study will be found, in enlargement of thought and in refinement of mind, amid the many cares of daily business; and in uplifting the character above narrow ends, and ignoble passions, and selfish aims. It gives dignity to life, as well as knowledge to the mind.'

REPORTS AND PROCEEDINGS.

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Dudley and Midland Geological Society.—On Tuesday, the first ordinary meeting of members for the present season was held in the Museum, Dudley. Mr. E. Fisher Smith presided.

The first paper was a communication from Mr. **Charles Twamley**, F.G.S., on 'The Faults of the South Staffordshire Coal-field, and their Relation to the Igneous Rocks of the District.' This paper was prepared for the British Association, but owing to its elaborate character it was necessary to give merely an abstract to the Geological Section. It was illustrated by an extensive series of diagrams, and dealt in detail with the history of the igneous rocks of the Coal-field, and the dislocations which they have caused in the Carboniferous Measures. The former Dudley Geological Society, in the year 1846, appointed a committee, consisting of Messrs. Beckett, Blackwell, Sparrow, and Twamley, to draw up a report on the faults of the Coal-field, and this led these gentlemen to institute a rigid examination of the district, but the results of their investigations were never published, so that this paper may be regarded as the embodiment of the work of this committee, supplemented by the researches of Prof. Jukes and others who have given attention to this subject. The author is of opinion that the igneous rocks of South Staffordshire were originally covered by the Permian, Red Sandstone, and probably by the Liassic Rocks, but that these have since been removed by denudation. He supposes that the Ludlow formation was not developed farther to the East than a line extending from Sedgley to the Trindle, near Dudley. The igneous force which produced the intrusions of rock now found in connection with the Coal-measures, acted in a direction almost due South from Hurst Hill, and first produced that eminence, and afterwards Wren's Nest, Dudley Castle and Nether Trindle Hills. He assumes that an immense thickness of igneous rock, probably little less than 4,000 feet, was by this means introduced beneath the area which now forms the South Staffordshire coal-field. After partially cooling, a portion was forced out underneath the Silurian Rocks of the Walsall district, bringing them up to their present inclined position, and the Rowley Hills' basalt was also forced out above the thick coal. This would produce a great depression between the above places, nd thus the series of faults east of Dudley (of which the Dudley Port trough faults are important features) were mainly produced. The igneous bosses at Pouk Hill, Barrow Hill, Dudley, and other places were fully considered, and their relationship traced to the aults in the several localities. The whole paper has an intimate bearing upon the mining interests of the district, and satisfactorily explains many of the peculiar disturbances by which it is raversed.

Mr. **Allport** called attention to the chemical analysis of Mr. D. Forbes, which appeared to prove that the South Staffordshire gneous rocks belong to the Secondary period. He considered that he author's theory of the complete denudation of the Red rocks was very probable, as such instances are not wanting in other ormations.

Mr. L. P. **Capewell** read a paper 'on the Metal Tungsten, its hemical combinations, and its alloys with iron and steel.' Specimens of wolfram, tungsten, deutoxide and sesquioxide of tungsten, hlorides and sulphides of tungsten, and tungstate of soda were exhibited. Referring to the alloy of tungsten and steel, the author howed specimens which were exceedingly hard, and much more ompact than ordinary steel. It was stated that this alloy will be nvaluable for making drilling instruments, &c., where great hardness is indispensable.

The next paper was by Mr. **Charles Ketley**, on 'The Dudley Silurian Rocks and their Fossils; remarks on the confusion existing n published lists and descriptions, with tables showing the distribution of the principal fossils.' This paper had special reference o the proper classification of a bed of shale lying immediately above he Wenlock Limestone of Dudley, and which has yielded some of he most interesting and beautiful of the organic remains from that district. The principal places where it has been exposed are the Dudley railway-tunnel, at the reservoir north of the Wren's Nest, at Spring House, and at Old Park, on the eastern side of the Wren's Nest. Unfortunately there are no good natural sections of it, for while two bands of limestone are well exposed in the caverns and at other points on the Wren's Nest and the Castle Hills, the only ection of this overlying shale is that at the railway station, Dudley. References to published descriptions show some confusion as to the name and physical relationship of this shale. In some it is classed as Lower Ludlow, and in others as Wenlock shale. Similar contradictions exist as to the localities of the fossils. Sir Roderick Murchison, Prof. Jukes, Mr. J. W. Salter, and the Dudley Geological Society, have in published works placed this shale in the Ludlow formation. The Geological Survey Map, the Jermyn Street Catalogue, and Professor Morris, are named as authorities for the pposite classification. That great confusion must arise from the present uncertainty as to which formation this bed really ought to be placed in, is evident, and hence the author has made a critical xamination of the fossil contents of the deposit, and has carefully ompared the lists with the organic remains found in the unde lying shale and limestone. According to the highest authorities, the two shales are lithologically undistinguishable from each other. The fossil evidence is, however, much more complete than it was a few years ago. Specific differences distinguish the fossils of the shale above the Limestone from those of the shale beneath, but the fossil evidence seems to show that the Upper shale has more intimate relationship to the Wenlock Limestone below than to the overlying Aymestry Limestone. Hence the author concludes that this deposit should be placed among the members of the Wenlock group. Extensive tables of the distribution of organic remains through the Silurian rocks of Dudley accompanied the paper.

A summary of these lists shows that of *corals* the Upper Shale has twenty-seven species, of which twenty-three are found in the Limestone below; but none of them are found in the typical Lower Ludlow Rocks of the Ludlow district. Of Trilobites the Upper Shale has twenty species and subspecies, fourteen of which are also in the Limestone below. The Lower Ludlow of the Ludlow district has eight species, four of which are also in the Upper Shale, and the Wenlock Limestone; and of the remaining species, three are in the Upper Shale, but not in the Limestone. Of Brachiopoda the Upper Shale has twenty-nine species, twenty-four of which are also found in the Limestone below. Of crustacea, again, the Upper Shale and the Limestone below have yielded specimens of *Ceratiocaris* and *Pterygotus*, which, until lately, had not been found below the Ludlow Rocks. Mr. Allport stated that out of thirty-four species of Trilobites found in the shales above and below the limestone, only three or four are common to both. He agreed with Sir R. Murchison and others, that the Upper Shale is the representative of the Lower Ludlow formation. Mr. Hollier said collectors had generally regarded the tunnel shale as belonging to the Wenlock formation. Some very interesting fossils from this formation were exhibited, including several undetermined forms from Mr. Capewell's cabinet; also a new star fish, from the same beds, belonging to Mr. Allport, and a fine specimen of *Lituites*, from Mr. Johnson's collection. The new Silurian genus of crustacea excited a good deal of attention. Until the character of these Dudley fossils was determined the Cirripedia were not known lower than the Rhætic beds, but now the finding of *Turrilepas Wrightii* shows the genus existed in the Silurian seas. This fossil has been known by the name of Chiton.

A chart of Fossil Crustacea,* prepared by Messrs. Salter and Woodward, was exhibited and described; also, specimens of Crinoidea, from the Mountain Limestone of Yorkshire, which have been recently presented to the museum by Mr. E. Wood, F.G.S., of Richmond.

The Geological Society of Norwich made an excursion to Hunstanton on the 22nd August under the guidance of the Rev. John Gunn, F.G.S., the president of the Society. About twenty members were present. The principal objects of geological interest were:—1, The Cliff-section at Hunstanton which exhibits the Lower Greensand, the 'Red Chalk,' and the Lower White Chalk (known as the 'Hard Chalk' of West Norfolk). The fossils met with in the 'Red Chalk' were stems of Encrinites, a fossil sponge, *Spongia paradoxica, Inoceramus Cuvieri,* and *I. Crispii, Belemnites minimus, Terebratula semiglobosa,* &c. The Red Chalk appears to be the equivalent of the Gault which at Norwich was reached at a depth of 1200 feet beneath the surface in Messrs. Colman's well at Carrow. Further inland Mr. C. B. Rose detected the red band graduating into the characteristic blue layer which forms the Gault. It also occurs in patches along the opposite Lincolnshire coast. 2, The Forest-bed, a continuation of that which may be seen at Hasboro', Bacton, Mundesley, and Cromer, and from which remains of Elephants, Deer, *Bos,* and many other animals have rewarded the researches of Mr. Gunn. At low-water the bases of old forest trees may be seen amid the ooze, their roots still stretching into the blue under-clay, and surrounded by a bed of lignite composed of fallen trunks, branches, and leaves, with cones of fir, and nuts of hazel, and rhizomes of the *Osmunda regalis.*

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* See Geological Magazine for October, p. 468.

II. At the usual Monthly Meeting held in the Museum Mr. J. Taylor (the Secretary) read an interesting paper on the Drift-beds in the neighbourhood of Saxlingham, Norfolk. The section exposed at Skates Hill gives 15 to 20 feet thickness composed of various beds of alternate clays, gravels, and sands. About midway in the section Mr. Taylor detected numerous fragments of shells, principally of *Cardium edule* and *Mactra.* A mile further, on the road to Saxlingham, another section was described composed of Brickearth and 'till,' also yielding shells.

The third section, 1½ mile distant, also Brickearth, some 10 or 15 feet in thickness contained immense quantities of fragments of shells and even some entire examples. *Mya arenaria, Cyprina Islandica, Tellina solidula, Mactra subtruncata, Cardium edule, Turritella commune,* were among the shells identified, besides numerous doubtful species. It was suggested that notes of local geological phenomena should be recorded upon a copy of the ordnance survey map of Norfolk to be kept for the use of the members.

Oswestry and Welshpool Naturalists' Field-Club.—This club held its third meeting for the season on Thursday, August 17th. The Geological section, after leaving the train at Trevor Station, proceeded first to inspect the quarry of the Messrs. Roberts, close by. This quarry is worked in the Millstone-grit, and affords a good section of the uppermost beds of that formation and of their junction with the lowest beds of the Coal-measures. The lowest seam of the latter is exposed at the entrance to the quarry, and rests upon the thick beds of sandstone in which the quarry is worked. The coarser layers of sandstone here are composed of fragments of Quartz in many of its varieties, firmly cemented together by Feldspar, and are quarried for millstones, while the fine beds admit of being worked for most architectural purposes. Some of the usual fossils were obtained at this spot. Another quarry in the same beds higher up the hill was next visited; and then the slope and the outcrop of the beds were traversed by the Members, who noted by the way points of resemblance to, or difference from, the same formation as examined by them in their last excursion at Sweeney. A fragment of a large Calamite was noticed upon a block of the Sandstone at Garth.

The junction of the Sandstone with the Mountain-limestone as exposed in the grand escarpment above Trevor was at length reached; and from this point the uppermost beds of Limestone were followed, and some examples of the interior of both the ventral and dorsal valves of *Productus giganteus* were obtained, as well as specimens of the large Coral—*Astræa carbonaria*, M'Coy,—which is found here in great plenty. A descent was then made down the precipitous escarpment to the horizon of the *Productus Llangollensis*, which is found in considerable numbers a little above the Red Marl—marked on the maps of the Survey as 'Old Red Sandstone;' and the excursion was concluded by a rapid walk over the Wenlock Shales to the town of Llangollen.—D. C. D.

RICHMOND FIELD NATURALISTS' CLUB.—On Thursday week the members of the Richmond and North Riding Naturalists' Field-club, by the kind permission of Messrs. Stobart and Co., paid a visit to the Newton Cap Colliery, near Bishop Auckland. About 60 were present, including several ladies. By the exertions of the President, Mr. E. Wood, F.G.S., every arrangement was made for the comfort of the excursionists, and the party took their departure from Richmond by the 9 o'clock train, reaching Bishop Auckland at 11 o'clock, and proceeded to the colliery, situate about a mile from the town. After some little delay in arranging the attire, the descent took place, under the able guidance of Mr. Lishman, the surveyor and agent. The 'Main' coal, the seam worked at the Newton Cap Colliery, is some 360 feet from the surface; and the mechanism for the descent is most perfect, the shaft being large, and the cages capable of accommodating 8 or 10 persons. In a short time the descent of the whole party was accomplished, and, being ushered into the 'Drawing Room,' a chamber at the foot of the shaft, which had been whitewashed and furnished with seats, the visitors were each provided with a candle and a clay holder. They then divided into three parties, each having a conductor, and visiting a different part of the pit. After walking for nearly a mile, they arrived at the portion of the pit where the men were hewing the coal, and full opportunity was afforded for gaining information respecting the method of working. The return was made in the wagons, and in due time the whole of the visitors were safely landed at the foot of the shaft. One subject of remark during the journey was the pure state of the atmosphere, the Davy lamp not being necessary in this pit; this is entirely attributable to the efficient state of the ventilation, which in the Newton Cap Colliery is effected by the closing up of all side outlets for the current of air, and by this means the heat of the furnace causes a rapid draught through all the open passages, the supply of fresh air coming down the main shaft. The furnace was the point next visited. Probably two tons of fuel were burning in a mass, and the front of the place was almost unapproachable within a few yards. The next visit was to the stables, where the ponies and horses used in the different workings are accommodated. Then the party ascended to *terra firma*, upwards of two hours having been spent in the pit. A sumptuous cold collation was provided by the President of the Club, at the Fleece Hotel, to which 66 sat down. At Darlington, the interval from 6 to 8 was profitably spent at the Albert Hill Ironworks, which through the kindness of the managers were thrown open to the members of the Club.

BRITISH ASSOCIATION REPORTS.

British Association Reports—Section C.

I. On Glacial Striation. By Prof. J. Phillips, F.R.S, President of the Association.

ON few subjects amid some apparent differences are geologists better agreed than on the general theory of the movement of glaciers on their inclined beds in the Alps, while on their former and permanent effects, as evidenced in the valleys and among the lakes of England, the differences of opinion are great.

The author believed that these differences ought to be brought to the test of accurate mechanical principles, as, for instance, the limits of effectual pressure to move ice forward on level surfaces and up ascending slopes; and confronted also with accurate notions and exact maps of special tracts selected for study. The author then described the special phenomena which had been observed by himself and Mr. J. E. Lee, of Caerleon, on a swelling ground at the foot of the Gôrner Glacier. In this case he showed that distinct grooves, beautiful striation, and polish, were traceable on broad flat surfaces of rock, protected by a shed, 150 feet above the actual bed of the Glacier, and about 100 yards from its base. Over this elevated tract in former years the Glacier must have passed, and this was quite consistent with the known physical constitution of ice and the slopes of the ground up which it is capable of ascending.

It is quite clear that on such ascending slopes the upward movement of the ice by the continuous pressure of the mass above is a real and necessary result.

The author next described the phenomena of glacial movement in Wastdale, and the features of Wastwater, a deep straight lake in Cumberland, three miles long. In Wastdale can be shown the reality of partial movements of ice in the valley; but from the great length of its lower part and the shortness of the slopes in ancient days, he concluded that continuous pressure could not be conveyed through the length of Wastdale. He also showed how a study of the relative degrees of grinding effected by solid bodies under different degrees of pressure, velocity, and inclination of the bed, led to the conclusion that if such pressure could be communicated it would not be effective in excavating the lake-basin at Wastdale. On the whole, he concluded that for a satisfactory explanation of the full effect of ice in valleys and lakes it would be necessary always to treat each case as a special problem by no means purely geological, but including and requiring important and quite practicable mechanical determinations.

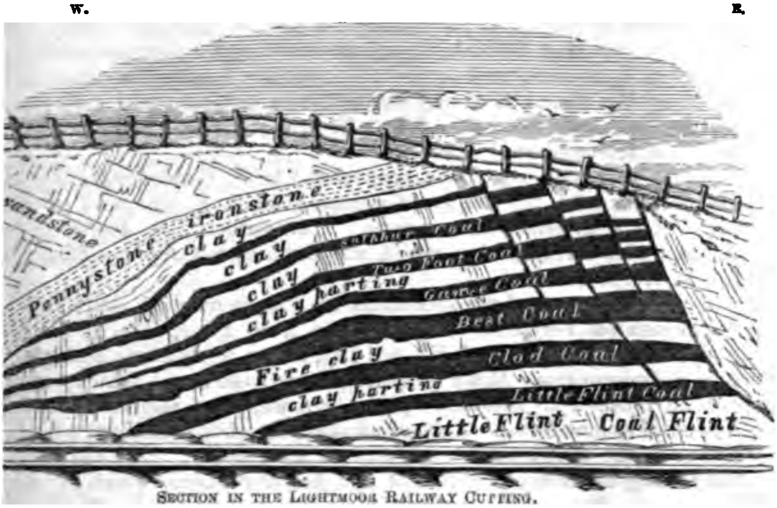
II. ON THE GEOLOGY OF COALBROOKDALE. By the Rev. W. Purton.

JUST where the valley of the Severn contracts towards the narrow gorge by which it passes through the great Limestone ridge of Wenlock Edge, it is met by the lateral valley of Coalbrookdale running down from the high table-land which forms the chief part of the Shropshire or Coalbrookdale Coal-field. The Dale, which is for the most part scooped out of the Wenlock shale, is joined about midway down by the Lightmoor hollow through which the railway passes, and which is excavated in the Lower Coal-measures, here faulted down, and is flanked at its entrance into the Severn valley by the rounded hill called Strethill on the north, and by Lincoln Hill on the south. At Strethill we find that mass of Glacial Drift, 200 feet in height above the Severn, which forms the subject of Mr. G. Maw's paper in the Quarterly Journal of the Geological Society, for May 1864, and which has served to prove that at one time during the Glacial epoch Wenlock Edge was the coast-line of the Irish sea, and the Severn Valley a marine strait. At Lincoln Hill, resting on the Wenlock Shale, the Wenlock Limestone is seen dipping at a high angle to the south. It is now worked in an extensive series of caverns, but in the old surface-workings we have an interesting section showing the Lower Coal-measures resting on the Limestone in the following order:—

1. Impure sandy limestone.
2. Limestone (chalkstone) 12 feet.
3. Conglomerate and sandstone, 13 feet, 6 inches.
4. Clunch, with balls of sandstone, 18 feet.
5. Coal, 'Lancashire Ladies,' 6 inches.
6. More clunch and sandstone, 12 feet.
7. A red and yellow 'pimply' rock, about 4 feet.
8. Whitish sandstone, 1 foot 8 inches. 'Crawstone Measure Crust.'
9. 'Crawstone' ironstone, 3 feet.
10. Sandstone, 'Flint Coal Flint.'

A walk of about a mile through the woods on the same side of the Dale will bring us to the quarry in Lightmoor Wood. Here we see, first, a white and brown Sandstone with plant-markings, 5 to 6 feet thick; the Crawstone-measure crust; then the Crawstone ironstone; above this a whitish Sandstone with fossil stems and roots of trees (*Sigillaria* and *Stigmaria*). It was from this quarry that the large fossil tree now in the possession of H. Whitmore, Esq., M.P., which was figured in the 'Illustrated London News' some two years ago, was procured. This last stratum is much stained by petroleum with which the rocks are saturated. Above it lies the 'Little Flint' coal, one foot thick, then a thin band of strong blue and yellow clunch; and then the 'Clod' coal, capped by a bed of clay.

In the Railway Cutting just below, no less than six seams of Coal are exposed, and though the section is abnormal, the measures being much compressed and brought exceedingly close together, it is a highly interesting one. Above the Flint and Clod-coal we see the 'Best' Coal, 'Game,' 'Two-foot,' and 'Lower Sulphur' Coals; and above the last, the 'Penny-stone' Iron-measure, capped by a bed of sandstone, which has been employed in building the bridges, &c. on the railway. In a brickfield about 100 yards to the north still higher strata are exposed, viz., Red Brick-clay, 8 feet; White Clay, 12 feet; Mottled Clay, solid below, sandy above, with nodules encrusted with iron ('snake heads'), and then the true 'Sulphur' Coal, or 'Stinkers,' usually found, as here, 9 or 10 yards above the 'Penny-measure.' Thus in a walk of little more than a mile we may see in open sections the whole of the Lower Coal-measures and a portion of the Upper.



SECTION IN THE LIGHTMOOR RAILWAY CUTTING.

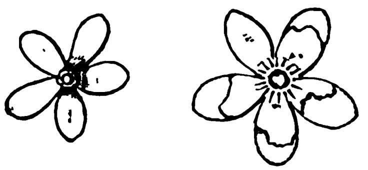
For a detailed account of the Shropshire Coal-field, the estuarine character of its strata, and its peculiar fossils, including several species of Insects and of the Limulus or King-crab, the reader is referred to Prestwich (Trans. Geol. Soc. 2nd ser. vol. v.), Hull, and the Publications of the Geological Survey.

III. ON SOME HITHERTO UNRECORDED LEAF-FORMS, FROM THE PIPE-CLAY OF ALUM BAY, ISLE OF WIGHT. By W. STEPHEN MITCHELL, LL.B., F.G.S., &c.

THOSE who have visited the western coast of the Isle of Wight will recollect that in Alum Bay the beds are tilted into a vertical position. About 200 feet from the base of the Lower Bagshot beds is a band of Pipe-clay, some 6 feet thick, crowded in one part with well-preserved plant-remains. The end of this band exposed in the cliff has been worked on several occasions, and Mr. Prestwich, Dr. Bowerbank, and two or three museums have obtained collections of the leaves. A list of the plants found has been given in No. 42 of the Geological Survey Memoirs. This list must not, however, be looked upon as complete, for further working brings to light many new forms. The author has had a collection made by Mr. Henry Keeping, the well-known geological collector, and he obtained some 350 leaf- and 50 fruit-remains. Some of these have not been recorded before.

In the collection is a *Ficus*, somewhat like *F. Bowerbankii* (De la Harpe), but with the angles of venation much greater, and it can hardly be referred to that species. The author also described a *Juglans* with serrated edge, which was certainly not *Juglans Sharpei* (De la Harpe).

There are two or three specimens of a large trilobed *Acer*, and a *Cinnamomum*, very like *C. Scheuchzeri*, from Bovey Tracey [Pengelly, Bovey Tracey, Pl. XVI. fig. 12], and a leguminous leaf, proably a *Podogonium*. Many other fragments were found, which could not be referred to recorded species, but were too imperfect to be described as new forms. A cone had also been obtained, about which, however, the writer would not venture an opinion. But the most interesting discovery was that of two flower-remains, which appear to resemble *Porana Œningensis* [Heer, Flora Tert. Helv. Pl. XVI. fig. 12.]. Adrawing of the two is given for comparison.



Figs. 1. and 2.
Porana (?) Vectensis, W. S. M. Pipe-clay of Alum Bay.

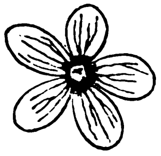


Fig. 3.
Porana Œningensis (Heer, Flora Tert. Helv., pl. xvi. f. 12). Miocene, Œningen.

The part preserved in the *P. Œningensis* must be the calyx, as the corolla is monopetalous. But for the finding of these solitary flower-remains in the Swiss Tertiaries, one would have been disposed to consider the Alum Bay specimens to belong to a polypetalous [pentapetalous] order; and the small elevations around the central disc might be viewed as the remains of stamens. The writer accepts provisionally the view of their belonging to the genus *Porana*, giving them the specific name *Vectensis*, in consideration of the points in which they differ from *P. Œningensis.*

The list, however, of the remains preserved in this bed is not to be completed without further working, in aid of which the British Asoociation have already made the author a grant.

IV. NOTICE OF THE OCCURRENCE OF CERTAIN FOSSIL SHELLS IN THE SEA-BED ADJOINING THE CHANNEL ISLANDS. By J. GWYN JEFFREYS, F.R.S.

IN the course of his dredging explorations this year among the Channel Isles, Mr. Jeffreys found shells of species, some of which are extinct, and one is not known to inhabit at present the North Atlantic. They were taken, with living mollusca, at depths varying from 12 to 20 fathoms, and in different parts of the sea-bed. The specimens in question had the same appearance as dead shells of recent species; one of them was in a most perfect state of preservation, and evidently had not been rolled or transported to any distance from its original place of habitation.

They consisted of *Potamides tricarinatus*, Lam. and *P. cinctus*, Lam. (both Eocene fossils), a species of *Terebratula* (or *Terebratulina*), which Mr. Davidson referred with doubt to *T. squamulosa* of Baudon (from the Calcaire Grossier), and *Rotalia* (*Discorbina*) *Trochidiformis* of Lamarck, also an Eocene fossil, but larger than specimens from the Bracklesham beds. No Tertiary deposit has been noticed in any part of the Channel Isles; but the discovery of the above-mentioned fossils in the adjoining sea-bed, occupying an intermediate position, would seem to connect this district with Hampshire and Normandy, and to show the great extent of the Eocene basin or area which formerly existed. Another species obtained by the same dredgings, near Jersey, was *Cerithium vulgatum*, Bruguière. Several specimens were found, one in a tolerably fresh condition. This species inhabits the Mediterranean and Adriatic, throughout many parts of which it is most abundant. It does not appear that living specimens have ever been found elsewhere, although Lamarck gave the North Atlantic as a locality. M. Cailliaud of Nantes included *C. vulgatum* in his list of mollusca from the Département of the Loire-Inférieure, having frequently met with shells thrown up on the beach; and Professor Sars recorded the discovery of a specimen inside a cod-fish caught off Bergen. Mr. Jeffreys believed that *C. vulgatum*, which usually inhabits large estuaries and salt marshes, once lived in such situations between Jersey and the mouth of the Loire, and that this tract has since been submerged, and consequently become unsuitable for the continued habitation of the *Cerithium*. The presence of submarine peat near the Channel Isles and in the bay of Mont St. Michel, tends to confirm the supposition, although it is by no means certain that the submergence has occurred within the historical period, as suggested by the Abbé Manet, Mr. Peacock, and others. Fossil shells procured by Mr. Jeffreys in his Shetland dredgings were of Arctic and high northern species; those now obtained were tropical and southern.

V. ON THE BRITISH SPECIES OF THE GENUS CEPHALASPIS, AND ON THE SCOTCH PTERASPIS. By E. RAY LANKESTER, Scholar of Downing College, Cambridge.

THE author of this paper stated that he had acquired a very large amount of evidence with regard to these remarkable fishes, by the kindness of various geological friends, in particular, Mr. Powrie, of Reswallie, Forfar, Mr. Lightbody, and Mr. Humphrey Salwey; and had also had access to the material collected by Professor Huxley. His investigations had led him to conclude that there were five British species of *Cephalaspis*, namely, 1st. The *Cephalaspis Lyellii*, of Agassiz, which appeared to be confined to Scotland, and perhaps the passage beds of Herefordshire, only represented in England by very well-marked varieties. 2nd. The common species of the Cornstones of England, which *might* be considered as identical with *C. Lyellii*, but appeared to differ much in the form of the head. 3rd. The *Cephalaspis Murchisoni* of Egerton, found in the passage beds near Ledbury. 4th. The *Cephalaspis Salweyi*, of Egerton, a species well characterised by its markings and the form of the head; and 5th. The *Cephalaspis asterolepis*, named by Dr. Harley, and distinguished by characters derived from the same parts as those of *C. Salweyi*. The *C. ornatus* of Egerton, Mr. Lankester stated, did not differ in its markings from the specimens of *C. Lyellii* lately obtained by Mr. Powrie, of Reswallie, and he therefore considered it not impossible that these were specifically the same forms. There was not, the author remarked, sufficient evidence to justify the specific separation of *C. ornatus*. In *C. Lyellii* there existed so great a tendency to variation in the length of the cusps, breadth, &c., that it was extremely difficult to indicate specific characters with precision. Some very remarkable specimens of *C. Lyellii*, exhibiting the body and its ornamentation, were exhibited, being from the cabinet of Mr. Powrie.

A Scotch species of *Pteraspis*, having the snout of *Pt. rostratus* and the disc of *Pt. Crouchii*, was then described. The name retained for this species is that given by Mr. Powrie, *Pt. Mitchelli*, in honour of the Rev. Hugh Mitchell, of Montrose, who had been the first to recognise the existence of *Pteraspis* in the Scotch area of the Lower Old Red Sandstone. A monograph on the Old Red Fishes is in preparation for the Palæontographical Society by Messrs. Powrie and Lankester, in which the various species of Cephalaspidian fishes will be first dealt with. Assistance in the form of loans of specimens will be very acceptable to the authors.

VI. ON THE LOWER LIAS OF LYME REGIS. By E. C. H. DAY, F.G.S.

THE Lias was defined by the author as commencing immediately below the 'Ostrea liassica' series (with the Insect-beds, of Brodie); the *true* 'White Lias' below, in his opinion belonging, both upon physical and palæontological considerations, to the *Rhætic* group of rocks.

The *Lower Lias* has been defined above by the upper limit of the zone of *Ammonites varicostatus*; and the author having accepted this definition in a former paper,* on the middle and upper divisions of this formation, he takes it as his boundary in the present description; but he does so, with the belief that such a division is purely arbitrary, and that there is not any physical or organic break which justifies the separation of the 'Middle' from the 'Lower' Lias, as two distinct formations.

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* Read before the Geological Society of London, 18th February, 1863.

The *Lower Lias* is divisible into a series of Limestones alternating with Marls, in the locality under consideration, about 80 feet in thickness, and a mass of Marls, in which the calcareous element is but slight, about 220 feet in thickness, making the total thickness of the Lower Lias, near Lyme Regis, about 300 feet. The lithological passage from the lower division to the upper is however gradual, and there is not any definite palæontological break between them.

The 'Limestones' (the 'Blue Lias Stone' of commerce) are the best known portion of the Lias. Their origin, as well as that of the nodules of limestone that occur in the marls above, are alike attributable to segregation from an originally calcareous ooze, and not to an alternate deposition of calcareous and argillaceous sediments.

The author next considers the distribution of the fossils of the Lower Lias in this neighbourhood, and his observations may be summed up as follows: that though the Ammonites of the Lower Lias have very restricted vertical ranges, and do occur in the order indicated by the supporters of 'Ammonitic Zones of Life,' yet that these ranges do not (except in special instances, where they are limited by a 'break' in time) define the range of any associated fauna. That Gasteropods are generally absent in these strata, their remains being mostly found confined to the lowest portions of the Limestones. That species of Mollusca, &c., occurring in the lower portion of the Limestones, recur here and there again, even as high as in the 'Marlstone' at the top of the Middle Lias. That the remains of the animal of the Belemnite are found in strata below any containing the 'guards' of the same genus; the Belemnites, commonly so-called, gradually increasing in frequency of occurrence from the appearance of the Limestones to the Belemnite-beds of the Middle Lias. That the Reptiles and Fish of the Lower Lias appear to have ranged vertically throughout it, as there is no species found commonly which the author could assert to be confined to any particular bed or zone; some species even passing into the basement beds of the Middle Lias.

From a consideration of these palæontological facts, and of the lithological conditions of the Lower and the Middle Lias, the author expresses his opinion that these so-called formations are but subdivisions of one formation representing the complementary deposits of one sea.

VII. On the Relative Extent of Atmospheric and Oceanic Denudation with a particular reference to certain Rocks and Valleys in Yorkshire and Derbyshire. By D. Mackintosh, F.G.S.

THE paper contained a modified re-statement of what had already appeared in the April and July numbers of this Magazine. [See article on the Brimham Rocks, and Surface-Geology of the Lake District.] The author brought forward a number of very

striking facts and considerations to show, that most of the inland pillars and projections of rock hitherto attributed to *weathering* are due to the former action of waves, tides, and currents; that many rocks are capable of withstanding atmospheric action for thousands, if not hundreds of thousands of years; and that the amount of atmospheric denudation is small, when compared with that resulting from the littoral action of 'the great excavator,' the ocean.

VIII. DR. A. LEITH ADAMS AND PROFESSOR BUSK communicated their FIRST REPORT ON THE EXPLORATION OF THE MALTESE CAVERNS.

THERE were two caverns in the island of Malta, one in the South-East, and the other in the centre of the island, in which remains had been found; in the latter the remains being those of the Elephant, and in the former chiefly Hippopotamus. Recently another cave on the south coast, and not 100 yards from the Phœnician ruins in that part of the island, had been discovered, and Capt. Spratt had found in it some remains, after which Dr. Adams proceeded with the further exploration of the cavern, resulting in the discovery of relics which proved that that part of the surface of the earth which now constituted the island of Malta was once the home of two species of Pigmy Elephant and one species of Elephant of the size now existing. The island would not now yield a month's food to many individuals, of even one species of Elephant; therefore, the island must at one time have joined to the opposite coast of Africa; and in this opinion the authors of the paper were supported by other considerations.

CORRESPONDENCE.

ON MACRAUCHENIA PATACHONICA.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—The most important and unexpected statement in Prof. Burmeister's account of the *Macrauchenia patachonica* relates to the dental formula which he ascribes to that genus and species; viz.,—

$$i\,\frac{3-3}{3-3},\ c\,\frac{1-1}{1-1},\ p\,\frac{4-4}{4-4},\ m\,\frac{4-4}{3-3}=40;$$

the exceptional fact being the presence of 16 teeth in the molar series of the upper jaw, instead of 14 as in all other Perissodactyles. in which the full type-number of the series is maintained. Of the 16 molar teeth thus assigned to the upper jaw,* Burmeister refers the 4 anterior ones on each side as the premolars (*muelas falsas*), and the 4 posterior ones on each side as the true molars (*muelas verdaderas*); the true molars being distinguished by their larger size, quadrangular crowns, and by having three roots instead of one.

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* 'La *Macrauchenia* tiene como el caballo, seis dientes incisiors en cada mandibula, cuatro colmillos chicos, ocho muelas en la mandibula superior, y solo siete en la inferior, de cada lado, es decir, en todo cuarenta y seis dientes.'—P. 42.

'Delante de la letra C de esta figura (pl. i. fig. 2) se ven dos aberturas negras, indicando los alviolos para dos dientes, que faltan; la primera pertenece al diente *canino*, la segunda á la primera muela.'—P. 37.

The number of true molar teeth 4—4 here ascribed to the upper jaw of *Macrauchenia* is not only an exception to the dental formula of Perissodactyles, but of all other Ungulates, and indeed of all diphyodont-placental mammals: it would be an anomalous resumption in the Ungulate order of a character of the Marsupial one. Again, the reference of the fourth grinder, counting from behind forwards to the series of true molars, gives a distinctive simplicity to the alleged four premolars in advance, which has hitherto been seen only in the Artiodactyle Ungulates, and which would be a more striking example of the tendency of the Perissodactyle *Macrauchenia* to the Artiodactyle order, than its cameloid cervical vertebræ, or its coalesced antibrachial bones.

After a careful study of the figures of the jaws and teeth in Pl. I of this interesting monograph, I am led to offer a different explanation of the phenomena. In the upper jaw of the incisive series the outermost only are in place, viz. *i* 3—*i* 3; these, with the alveoli of *i* 2, *i* 1, *i* 1, *i* 2, form, as in the horse, a convex curve at the anterior boundary of the upper jaw.

After a short interval or 'diastema' behind *i* 3, there is either a single alveolus for the bifid base of a canine tooth, or two small confluent alveoli for two distinct small, simple-rooted teeth. Prof. Burmeister adopts the latter view, ascribes the anterior depression to a small single-rooted canine, and the posterior one to a similar premolar, which is accordingly the first of that series. Immediately behind the empty socket is the first of the premolars in place, with a crown equalling in antero-posterior extent the antecedent double-pitted alveolus. To judge from the socket of the mandibular tooth answering to the first maxillary premolar in place, and from the appearances in the side view of the same tooth, in pl. 1, fig. 3, I infer that the maxillary premolar, with the mandibular one, was implanted by a partially or wholly divided fang, in a two-holed socket; the same is more plainly the case in the second premolar in place; whilst the third, having acquired a greater transverse thickness of crown, may have also a third fang or rudiment of one, on the inner side of the two principal fangs. The fourth molar, in place, with a further increase of transverse diameter of crown, resembles the three succeeding true molars in the general pattern of the grinding surface, having an antero-posteriorly extended enamel lined depression on the outer half of the crown, and two round enamel islands, one behind the other, on the inner half of the crown.

Now, my interpretation of the foregoing appearances is, that the upper canine was implanted by a compressed, antero-posteriorly extended fang, pinched in the middle so as to approach to a division of it into an anterior and posterior root, and with a correspondingly partially divided socket: it may be that the base of such fang of the upper tusk or canine was actually divided, or bifid. The mammalia are not wanting in examples of canines so implanted. According to this view, the hinder division of the empty socket, behind the outermost incisor, did not contain a distinct tooth from the canine, but only the hinder division of the base is a canine. In this case the first premolar in place is *p* 1; the fourth, which has assumed the complex character, shape, and almost size of the true molars, is *p* 4. The number of true molars then enters into the rule, viz., three on each side, as in the lower jaw. I feel very confident that when the permanent upper canine of *Macrauchenia* be found, it will confirm the interpretation above given of the dental formula of the upper jaw. In the lower jaw of the *Macrauchenia* (pl. 1, figs. 3, 4, 5, 6), all the incisors are wanting, the fang of a simple-fanged small canine is near the outer incisor; a very short diastema divides the canine from the first two-rooted premolar, which, with the second, is wanting: *p* 3, *p* 4, and *m* 1, 2, and 3 are in place. The lower jaw differed from the upper jaw, in its dentition, not in the number of teeth, but by the smaller size and simpler implantation of the canine, as well as by the difference of size and modified character of the grinding surface of the molar teeth, exemplified in my 'Odontography,' and in Burmeister's edition of poor Bravard's excellent drawings of the skull of *Macrauchenia.*

Reasoning on the basis of the foregoing interpretation of the dental system, I conclude that *Macrauchenia* manifested the essential Perissodactyle position to which it was originally referred, by the extension of the character of the true molars into the premolar series; but, as in the Tapiroid genus, in which Cuvier first pointed out this deviation from the dental character of the type-Perissodactyles, 'the premolars offer some differences from the true molars.'*

In *Lophiodon*, however, as in *Pliolophus*, the last premolar *p* 4, differs from the first true molar *m* 1 in the reduction of the two inner lobes of the crown to one large conical lobe: the penultimate premolar *p* 3 resembles the foregoing, but is of smaller size; the antecedent premolar *p* 2 is suddenly reduced in size, and the inner lobe is almost obsolete. *Lophiodon* has no *p* 1. The three molar teeth of *Lophiodon Isselensis* (Cuv.) figured in tom. cit. pl. vi., fig. 2, are *m* 3 ('*n*'), *p* 4 ('*o*') and *p* 3 ('*p*'): they well exhibit that character. In like manner *Paloplotherium* differs from *Palæotherium*, in the almost suppression of the hinder of the inner pair of lobes in *p* 4. In *Macrauchenia* the difference between *m* 1 and *p* 4 is rather one of size than of structure, but the simplification of the crown is well marked in *p* 3, and is carried out in *p*. 2 and *p*. 1. *Palæotherium* resembles *Equus* and *Rhinoceros* in the conservation of the type of structure of the true molars in all the premolars save the first, which in *Equus* is represented only in the deciduous series;

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* 'D'un genre d'animaux voisins des tapirs,—mais dont les molaires antérieures et postérieures effroient quelques différences: genre auquel je donne le nom de *Lophiodon*.' Op. Foss., 4to., 1822, tom. ii., p. 176.

but in *Palæotherium* there is a gradual diminution of size from *p* 4 to *p* 2 and a sudden one in *p* 1. In *Tapirus*, *p* 3, *p* 2, and *p* 1 of the upper jaw progressively depart from the true molar type, as well as diminish in size.

RICHARD OWEN.

PERMIAN STRATA IN THE VALE OF CLWYD.

To the Editor of the GEOLOGICAL MAGAZINE.

DEAR SIR,—The letter from Mr. Davies in your last number compels me to again trespass on your space, with a little further explanation of the evidence upon which I premised the existence of Permian strata in the Vale of Clwyd, and the erosion of the Carboniferous rocks before their deposition.

I fully agree with most of the generalisations expressed in the early part of Mr. Davies's letters, and I can assure him that the points he mentions had not escaped me in weighing the evidence bearing on the age of the strata at Pentre Celyn.

When strata become either entirely 'thinned out,' or reduced in thickness by causes connected with their deposition, the reduction in their bulk rarely takes place abruptly, but generally by a somewhat regular rate of diminution. For instance, if a particular formation diminishes to half its thickness in a given distance, say 20 miles, it will only have lost one fourth of its thickness in half the distance.

The Lower Carboniferous rocks in North Wales and the west of England are remarkably consistent in this respect over a very large area; and there is perhaps no class of evidence which more conclusively proves that the various separate masses and outliers of Carboniferous Limestone and Millstone Grit once formed an unbroken and connected deposit, than the regularity with which their thickness diminishes both from the NW. and SW. towards the middle of England. In the north-west of Wales the Carboniferous Limestone attains a thickness of at least 800 feet. At Llanymynech, on the borders of Shropshire, its thickness is reduced to about half; and following the same rate of diminution in a south-easterly direction, the Limestone is only 30 or 40 feet thick round the flanks of the Wrekin, and becomes entirely lost under the Shropshire Coal field.

The same regularity of diminution is observable from the SW., where by regular steps it becomes reduced in bulk from the great mass underlying the Bristol and South Wales Coal fields, through Farlow in the SW. of Shropshire (where it is considerably diminished) until it thins out to nothing in Shropshire and Staffordshire.

The Mountain Limestone, overlain by a great mass of Millstone Grit, occurs but a few miles to the east of Pentre Celyn, exposed as bold escarpments, and about two miles to the north, a small outlier of the Millstone Grit crops up in the vale.

At Pentre Celyn no Millstone Grit occurs, and the Limestone is unusually thin. Now, as the absence of the Millstone Grit at this point, on the theory of 'thinning out,' is entirely inconsistent with its general uniformity in North Wales, or any rate of diminu[illegible] which its thickness varies, is it not more probable that the same denudation which has produced in North Wales the numerous escarpments of Lower Carboniferous rocks, has also cleared away the Millstone Grit and part of the Limestone at Pentre Celyn?

It did occur to me that the Pentre Celyn marls and shales might be some part of the Coal Measures; but, on the other hand, it appeared less likely that a break should occur (implied by the erosion of the Millstone Grit) between the Coal Measures and the Lower Carboniferous rocks, than between the Permian and the Carboniferous series; and the close mineralogical resemblance of the strata at Pentre Celyn to the Permians in other localities seemed to warrant the conclusion expressed in my letter to the Magazine.

Since it was published, I have again visited Pentre Celyn, and was fortunate in meeting with a number of plant impressions in the marly shales found in Mr. Edward's pits. Mr. Etheridge has kindly examined them for me, and states '*they are Permian or Lower New Red species, differing in all respects from Carboniferous.*' The fact is interesting, not only as affording evidence of a great erosion of the Carboniferous rocks before the deposition of the Permians, but as illustrating the possibility of the conformity of strata separated by an interval of denudation.

Similar strata to those at Pentre Celyn intervene between the Bunter Sandstone and Carboniferous Limestone in several localities along the east side of the vale of Clwyd, as in the wood above Llandibr Farm (between Llandibr and Llangynhapal) and at Rhiw Bibbil, opposite Denbigh, &c. Is it possible that the beds Mr. Davies noticed crossing upon the western side of the vale, between the Limestone and the Sandstone in the cuttings of the Rhyl and Denbigh Railway, and supposed by him to be Coal measures, were Permian, similar to the strata on the east side of the vale of Clwyd? —I remain, dear Sir, very truly yours, GEORGE MAW.

BENTHALL HALL, BROSELEY, *Oct.* 7, 1865.

GLACIAL STRIÆ IN THE COUNTY OF LONGFORD.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—In the last number of the GEOLOGICAL MAGAZINE there was an illustrated paper by Mr. A. H. Green, describing some supposed ice-scratches on a Limestone rock in Derbyshire. Mr. Green states that the Limestone is 'studded with dark red patches of chert, which have been polished down to a smooth surface, and scored over with grooves and scratches.'

A similar instance occurs in Co. Longford, Ireland. On the northern slope of Slievegalry (a hill some five miles SSE. of Longford town, and 650 feet above the sea), there is a considerable exposure of Conglomerate (Old Red), dipping N 30 W at about 8°. It consists of numerous pebbles and small boulders of quartz, and occasionally jasper, firmly cemented together in a base of coarse yellowish or reddish white sand.

The pebbles have been worn and polished down to a flat surface, and are sharply scratched and scored by striæ which bear N 30 W and S 30 E. It is a most singular-looking rock-surface, and well worth a visit. Its exact situation is in the townland of Lisduff, at the south side of the road leading from Moydow to Ardagh, a little to the south of the letters I and S in 'LISDUFF,' 6-inch ordnance sheet, Longford 19. There can be little doubt as to the glacial origin of the striæ, as they coincide in direction with other striæ seen in several parts of the Longford district.

It is probable, too, that the ice-current came from the NW., or up the slope of the hill. We have no actual proof of this at Slievegalry; but about ten miles to the westward a very remarkable erratic is traceable to its parent rock. It is a hard, homogeneous, amorphous, blood-red jasper rock, and occurs *in situ* near the summit of Slievebawn Hill, 857 feet above the sea. A large block of this rock may be seen perched on a drift-covered hill at Rathcline, on the east shore of Lough Ree, somewhat less than six miles in a direction of S 30 E from the summit.

The ridges also, whether of rock or drift, and the stream-courses in this part of the country, exhibit a general parallelism in this direction, as also do most of the observed striæ, so that there is strong evidence that the district was at one period covered by an ice sheet moving from N 30 W to S 30 E. F. J. FOOT.

GEOLOGICAL SURVEY OF IRELAND.
BOYLE, IRELAND: *Oct.* 11, 1865.

PRIMARY AND SECONDARY STRIÆ.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—I am glad to find by Mr. Green's paper in your last number, that he also has remarked the *Primary* and *Secondary* striæ. In this neighbourhood I have observed three sets; the general bearing of the oldest being about N 30 E., of the second N 30 W., and of the newest nearly E and W. The first have a similar bearing to the axis of the 'dressed hummocks' of rock, and also the primary striation in the rest of Galway and Clare; the second agree with the general bearing of the valley now occupied by Lough Corrib; while the newest are perpendicular to the mouth of the valley that lies between Oughterard and Cliften, and also to the east slopes of the hills.

I would therefore *suggest*, that the first were made by the movement from NE. to SW. of the ice-field which is supposed once to have covered Ireland—that as the land sank, local systems of glaciers were formed, one of which occupied the valley of Lough Corrib, while its branches came down the different mountain-valleys. This glacier of Lough Corrib formed the second set of striæ; and as the land was still sinking it gradually melted away, while the glacier in the Oughterard valley remained longer and formed the third set of striæ. Would Mr. Green look at the features of the country in which he has remarked the striæ, and see if he could account for them in a similar way? J. HENRY KINAHAN.

OUGHTERARD: *Oct.* 3, 1865.

THE BLOODY STONE.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—The paper by Mr. Green in the last number of the GEOLOGICAL MAGAZINE on the supposed ice-marks on the Bloody Stone, between Cromford and Bonsall, led me, as Mr. Mackintosh's letter had led him, to pay a visit to the spot, in hopes of discovering something more. My hopes in that respect were however not realised; but I saw what Mr. Green saw, and tried to take some rubbings from the smoothest parts of the grooved rock I could find. I send them to you with this, in case they should prove an additional help, in the absence of better, towards solving the question whether the markings are glacial or not. The three large rubbings are from different parts of the surface marked F in Mr. Green's ground-plan, two of them (the two smaller) were taken close to where the line HK cuts the rock. The small rubbing is from a fragment of the rock near D, it is well polished, and the grooves were nearly at right angles to the footpath. I have sketched in the rest of the specimen in order to show the distinct division between the chert and the Limestone. The grooved rock could be traced some way beneath the path by clearing away the earth and stones, and more could be seen in other places by removing the turf. I could discover no further traces of ice-work in the neighbourhood. A rough observation taken with a pocket aneroid gave about 246 feet as the height of the Bloody Stone above the toll-gate at the foot of the bridle-path to Bonsall, and I should think the Stone would be about 300 feet above the Derwent. May the rounded form of the hill be due to ice-work? The opposite side of the dale consists of steep and well-wooded Limestone cliffs. A small stream widened into ponds runs along the bottom of the dale. The bearings laid down on the rubbings are magnetic.—I am, &c.

J. MAGENS MELLO, M.A., F.G.S.

ST. THOMAS' PARSONAGE, BRAMPTON,
CHESTERFIELD: *Oct.* 7, 1865.

NOTE.—We have received the rubbings of ice-markings referred to above, and also a general sketch of the locality, and regret that want of space does not admit our reproducing them here. The rubbings of the striæ present all the appearance of having resulted from ice-action.—EDIT.

GLACIATION IN DEVONSHIRE.

To the Editor of the GEOLOGICAL MAGAZINE.

DEAR SIR,—In connection with the interesting record made by Professor Jukes in the October number of the GEOLOGICAL MAGAZINE, I would briefly notice the existence, in North Devon, of what appears to be an extensive deposit of Boulder-clay. At the hamlet of Roundswell, a mill to the SW. of Barnstaple, a well was sunk in *1862* by Mr. J. Bowden through a thickness of 40 feet of clay, the great bulk of which was devoid of anything like stratification, exceedingly tough and smooth, and in all respects resembling Boulder-clay, excepting that it is browner in colour than that occurring on the North Welsh coast.

At a height of from 30 to 40 feet above the sea, it rests on a continuation inland of the raised shingle-bed on the banks of the river Taw described by De La Beche. The clay near Upper Roundswell appears to be nearly 90 feet, and from this point, which is given 115 to 120 feet above the sea, it gradually falls away, and thins out to nothing towards the east and west. The clay has for many years been worked near Fremington towards the western extremity of the mass for the manufacturing of earthenware. Mr. E. B. Fishley, the proprietor of the pottery, showed me several large blocks that had been found in the middle of the deposit; they were unaccompanied by smaller stones. One of them, a mass of Basaltic trap 3½ × 2½ × 2 feet, weighing many hundredweights, was, at the time of my visit in March 1862, to be seen in the hamlet of Combrew, and a smaller mass of Amygdaloid trap in the yard of Mr. Fishley's pottery. Neither of them bore any marks of glacial striation; but they must have come either from the confines of Dartmoor, a distance of at least twenty miles, or from South Wales; and it appears impossible to account for their position, except on the theory of ice-transport. A fuller description of the Fremington deposit will be found at page 445 of the 20th vol. of the Journal of the Geological Society.—I am, &c. GEORGE MAW.

BENTHALL HALL, NEAR BROSELEY: *Oct.* 10, 1865.

THE PHOSPHATE-BED AT FOLKESTONE.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—Mr. Seeley, in his paper on the 'Sequence of Rocks and Fossils,' speaks of the '*phosphate-bed* at Folkestone, as being in all probability of plant origin.' As from observation I believe it to be of animal origin, I send you the following facts.

Below the phosphate-bed is a seam of *Ammonites mammillaris*, two or three inches thick, resting on the Lower Greensand. Above the said bed is a seam of *Ammonites dentatus* and *mammillaris*; the two seams and the phosphate-bed forming the junction-bed of the Greensand and Gault.

This junction-bed contains rolled water-washed *Ammonites*, with nodules of phosphate adhering to them; drifted wood, containing *Pholas*, *Teredo*, *Fistularia*, vertebræ of *Ichthyosauri*, and the phosphatic *nodules*, which, in nine cases out of ten, are plainly Molluskite, generally *Rostellariæ* and *Pteroceræ*. On the *little* phosphate seams between the beds of the Folkestone Gault I can *give* further detail, if of interest.

Sir, yours, &c. C. E. R.

BEAMINSTER.

MISCELLANEOUS.

Mammalian Fossils from Uruguay.—The richness in fossil Mammalian remains of some of the newer Tertiary deposits of South America is shown by a small collection of bones recently presented to the British Museum by David A. Stoddart, Esq., which were found in a bank of shingle in the Rio Negro, Banda Oriental. In the collection are the remains of several genera, amongst which is a skull of a small but adult *Mastodon*, together with several detached teeth of the same genus, and also of *Megatherium*, *Mylodon*, *Scelidotherium*, *Toxodon*, and part of the cranium of an animal allied to *Toxodon*, portions of antlers of Deer, a femur of a large Carnivore, and several pieces of carapaces of more than one species of *Glyptodon*, one of which is new. The fossils are in different states of preservation; for whilst the structure of the bone of some is scarcely altered and but little injured by rolling, others are much water-worn, and have undergone a complete lithological change.

The attention of travellers about to proceed to South America is directed to the important fact, that notwithstanding the labours of Cuvier, Owen, Lund, &c., in describing, and of Sir Woodbine Parish, Bravard, Claussen, and others in collecting, there is much to be added to the wonderful and peculiar fossil fauna of the South American Continent; and there is abundant proof that these remains abound, not only in its mountain-caves, but also in the banks of its numerous and large rivers, and in its extensive plains.—W. D.

Geological Anecdote of Mr. George Stephenson.[*]—Mr. Stephenson had some interest in a coal-mine near Ashby-de-la-Zouch, Leicestershire. After much expense had been incurred, and before a sufficient depth had been attained to render the mine a paying speculation, all efforts were one day suddenly interrupted by a mass of granite-rock. It was the general impression that the miners had reached the supposed granite nucleus of the earth. But Mr. Stephenson, from his own observation and reflections, had previously arrived at the conclusion (afterwards corroborated) that granite-veins may belong to any period, and may be found intruded among strata of Secondary as well as Primary origin. Accordingly he went down to survey the plutonic intruder, and the following are his characteristic words:—'I looked the fellow round about: I saw he was a stranger who had no business there; and I thought I would have a good rattle at him.' After rattling at the granite for only a very short time, the miners got through it; more productive Coal-measures were found underneath; and I have lately been informed that the mine is still worked with profit to the proprietors.—D. M.

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[*] This anecdote was communicated to the writer about eighteen years ago by one of Mr. Stephenson's mining-agents.

THE

GEOLOGICAL MAGAZINE.

No. XVIII.—DECEMBER 1865.

ORIGINAL ARTICLES.

I. ON A SECTION DISCOVERING THE CRETACEOUS BEDS AT ELY.

By HARRY SEELEY, F.G.S., Woodwardian Museum, Cambridge.

EXCEPT in containing small nodules of phosphate of lime, the Chalk shows no structural change where it terminates in the Ely section, but passes down almost imperceptibly into a dark greenish layer, and rests on it at an angle of about 35°. This greenish band, scarcely a foot thick, is full of nodules of phosphate of lime, and consists largely of glauconite. It is the Upper Greensand, with *Ammonites auritus*, *Terebratula biplicata*, *Dentalium ellipticum*, and the usual local features. Nowhere can the passage of one *rock* into another be more marked than that of the Upper Greensand of this district into the Chalk. Conditions have changed a little with physical geography, but nothing suggests any break in time. About Cambridge the section is exactly the same; the Chalk just above is often flaggy, contains a few green grains, a little phosphate of lime, and the commoner Greensand fossils mixed with those of the Chalk. Sometimes, however, there are some 10 or 12 feet of dark greyish-green marls above the Upper Greensand. They are separated by sharp lines of bedding from the Chalk, are very local, and perhaps only indicate a trifling denudation of the Gault.

The fossiliferous bed, consisting of a soft dark-greyish marl, which is largely charged with dark-green glauconite and black nodules of phosphate of lime, is rarely more than a foot thick. Nowhere are there any hard beds in it, and nowhere any iron pyrites. In quarrying, the deposit is removed bodily, showing the old Gault bottom with hollows and unevennesses, often containing groups of associated bones belonging to one animal; and sometimes discovering slight faults, which show the usual glistening sides.

The Upper Greensand (*d*) has been found everywhere at the base of the Chalk, and extends obliquely over Cambridgeshire by way of Mildenhall, Isleham, Burwell, Swaffham, Quy, Waterbeach, Fen Ditton, Barnwell, and the zigzag of low Chalk hills extending round Madingly, Coton, Comberton, Barton, and Granchester, and so makes its way south-west. Very many sections have been exposed all along the line of its outcrop, away to Bedfordshire. But from its thinness, it forms no feature in the country. Outliers, and especially one between Ely and St. Ives, at Haddenham, show that it was formerly wider spread.

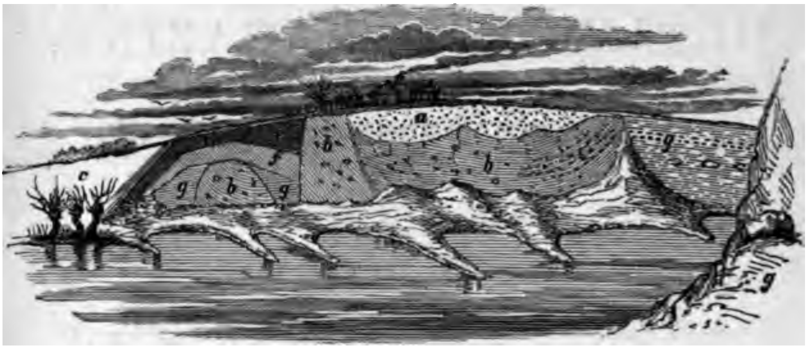

Fig. 1.—SECTION NEAR ELY.

a. Gravel. *b.* Boulder-clay.. *c.* Chalk. *d.* Upper Greensand (between *c* and *e*).
e. Gault. *f.* Shanklin Sand *g.* Kimmeridge Clay.

It is out of this insignificant stratum, constant in thickness as it is in position, and extending over the county from Ashwell to Mildenhall, that the Woodwardian Museum has been enriched with 300 species of Invertebrata, and a multitude of Fishes, Reptiles, and Birds; among the latter being *Palæocolymbus Barretti*, *Pelagornis Sedgwicki*, and nine species of Pterodactyle, which are not Reptiles, but form a class of Aves called *Saurornia.*

A little north, in the Ely pit, the Upper Greensand rests on an ash-grey clay, which is the Gault (*e*), not more than 20 feet thick. It extends in a curve from the base of the section on the south to its top on the north; but the upper part is denuded, and the lower part is concealed with drift. In it are scattered spherical nodules of phosphate of lime, two or three inches in diameter, but unlike those of the Greensand in not being rolled. There nowhere is seen that passage from Gault to Greensand which there is from Greensand to Chalk; but the sections show no unconformability.

Accustomed to associate phosphatic nodules with numerous vertebrate remains, their presence here, as in the Hunstanton Red Rock, seems unnatural. But neither here nor in the Greensand are the nodules coprolitic. They are in all cases rolled shore accumulations or concretions. The Apatites of Europe and America show no evidence of animal origin; on the contrary, one in Bavaria contains *Iodine*, a substance eminently vegetable. And as *Zostera* and many sea-plants contain a notable per-centage of phosphate of lime, it is not impossible that shore plants, and plants growing over submerged lands, as the Gulf-weed *Sargassum*, may by decomposition have supplied the phosphoric acid now stored up in the Cretaceous strata.

So full of pounded and rolled shell-fragments is the Gault in this Ely Section that it looks as though it might represent the entire Gault period. There are multitudes of compressed *Pernæ* in every block; the species is *Perna concentrica* and its varieties. Here also are found *Belemnites minimus* and *B. attenuatus*, *Ammonites proboscideus* and *A. auritus*, *Perna sulcata*, *Nucula pectinata*, &c. &c.

The Gault is also fossiliferous at Haddenham, where it was first found by my late friend Lucas Barrett, who collected from it *Edaphodus Sedgwicki*.

Approaching Cambridge it thickens to 150 feet, and the upper part becomes unfossiliferous, only yielding to years of search a small Ichthyosaur, a Siluroid fish-spine, *Ammonites splendens*, *Plicatula pectinata*, and a few spines of *Diadema*.

It generally may be recognised by the flatness of its surface and the course of streamlets along it.

The Gault (*e*) is seen to rest on a brown ferruginous sand rock, which is the Shanklin Sands (*f*). This deposit, too, has by dislocation been bent into a curve, and in several places the rock has snapped, and there are breaks of several feet, into which the Gault has been squeezed so as to look as though deposited on the Kimmeridge Clay. All the beds have been roughly handled, and in places the older clay has been squeezed into slight folds under the Shanklin Sands.

The lower part of the Shanklin Sands is a conglomerate of small rounded pebbles, which in the best place in the section is hardly more than four feet thick, and above this are some brown sands alternating irregularly with thin courses of clay with phosphatic nodules; and in places these deposits almost stand on end through false bedding. They are seven feet thick, and unfossiliferous, a good deal resembling the beds below; but I cannot say they should not be classed with the Gault. A rolled fragment or two of *Ammonites biplex* is the only fossil I have found in the rock; so that it might be Portland Sands but that it is traced to Hunstanton, where fossils are more numerous. It caps the Ely Hill, and to judge by the city walls was at one time largely quarried. Other outliers of it are seen at Haddenham, where it is twenty feet thick, and at Cottenham; though I failed to find it at Denny Abbey. About five miles NW. of Cambridge it crosses the Roman road and forms a bright brown strip in the fields: here, at Oakington, it has yielded a large *Panopæa*. It is well seen again at Great Gransden, showing an unusual amount of false bedding. And near by at Caxton a well was sunk through twelve feet of Boulder-clay to Shankin Sands, which gave the section—

Ironstone Clinkers, 1½ feet;
Ferruginous Sand, 10½ feet;
Bright-green Sand, 3 feet.

Plenty of water coming in, the latter bed was not pierced. At Bourn, the sand, which is full of bands of clinkers, contains much carbonized wood. At Gamlingay the wood was compressed, infiltrated with iron, and drilled by *Teredo.* Near Potten a section shows a seam about nine inches thick, of perfectly rounded and rather large pebbles, between fine sand. At Sandy, resting on the Oxford Clay, the pale ferruginous sands form a cliff nearly 100 feet high overlooking the western plain.

At Ely the Sand-rock appears to rest quite conformably on a dark slate-blue clay containing *Lingula ovalis,* which is Kimmeridge Clay (*g*). So that though in a diagram section in a former paper (vol. I., p. 151), Chalk and Kimmeridge Clay stand side by side, yet in another part of the section the missing beds, very thin, are found in their proper places; so that the fault at the north end of the pit, where least, has only let down the Kimmeridge Clay for some thirty feet, bringing its upper beds low in the section.

The clay has the usual shaly laminated character, with large septarian concretions in layers, and numerous fossils, but they are compressed, and the frailest occur as casts. *Ammonites biplex, A. perarmatus, Patella latissima, Exogyra virgula, Ostrea læviuscula, Lingula ovalis,* and *Serpula tetragona* are the commonest fossils. *Trigonellites* are very numerous relatively to *Ammonites,* and in the upper part of the bed there is a good deal of wood.

The Reptiles are species of *Ichthyosaurus, Plesiosaurus, Pliosaurus, Stenecosaurus, Teleosaurus, Chelonia,* and perhaps *Iguanodon.* The Fishes are species of *Asteracanthus, Pycnodus, Gyrodus, Hybodus, Cœlacanthus,* and *Edaphodon,* with *Sphenonchus.*

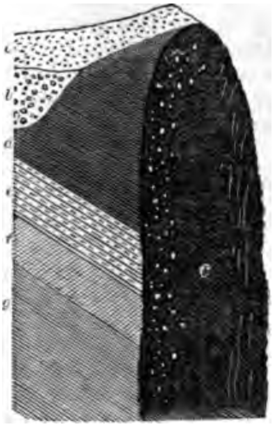

Fig. 2.—SECTION IN THE ELY PIT.

a. Surface-gravel. *b.* Gravel. *c.* Boulder-clay. *d.* Gault. *e.* Alternations of Clay and Sand. *f.* Shanklin Sands. *g.* Kimmeridge Clay.

At the point in the general section where the Cretaceous beds are broken off by Boulder-clay is the section, Fig. 2, taken at right angles to the other, which shows that, instead of being wanting, the

Cretaceous beds are merely obscured by Boulder-clay let down in front of them, so that the fault may be much less than it appears to be. It is the same downthrow fault which lets down the Boulder-clay in front of the Shanklin Sands (Fig. 1). Another fault lets down Boulder-clay under the Chalk.

The Boulder-clay (Fig. 1. *b*) forming the greater part of the section is a drab-coloured clay, full of all sorts of rocks: it reaches from the bottom to the top of the pit, some forty feet. There are boulders of Mountain Limestone two or three feet in diameter, smaller pieces of Lias, and nearly all the Oolites; Greensand Fossils, and masses of Chalk in plenty. At one place in the section the upper part is devoid of pebbles and boulders, and at the north end there are rough courses of nodules making a kind of curved stratification. The only contemporary fossils that I have found in it are some very old and thick specimens of *Tellina*. The junction with the Kimmeridge Clay at the north end is not clear, but it is almost certain that the Kimmeridge Clay extends in front of it.

This faulted condition of the Drift, which stands quite perpendicular, side by side, with the older beds, is of peculiar interest as indicating its age to be probably anterior to the present form of the country, for all trace of the Boulder-clay is removed from the surface round about.

This clay is capped with about fifteen feet of gravel, which is interesting as being in part interstratified with the Boulder-clay.

This section (Fig. 1), so singular in the thinning off of all the Cretaceous strata, offers a few points for consideration.

The Shanklin Sands, which in Bedfordshire are very thick, gradually thin off in a wedge to a few feet. There they rest on Oxford Clay, here on Kimmeridge Clay. The Gault thins off similarly in the same direction. The Greensand is constant, and the Chalk shows no sign of change.

The wedge-like form of Shanklin Sands may result from the material of which it was built up having become less abundant to the north-east, and so the representation of as much time is compressed into four or five feet as is elsewhere represented by several hundred feet. The small pebble character of the bed does not indicate that it was accumulated far out at sea, where currents had no longer power to bear its material. And had it been formed near the source whence derived, where a shallow sea prevented a thick formation, the component particles, which are rarely more than half an inch in diameter, would have been larger; and the absence of fossils is noteworthy. Hence, as it is so thin, and so like ordinary and far thicker sections, it seems almost certain that the deposit only represents a part of the formation. That part does not appear to be the newest, for if it did, as there are no breaks in nature, it would pass up insensibly into the Gault, whereas there is an intermediate thickness in which the beds irregularly alternate; which indicates not a gradual but a sudden change, such as depression of what had been land. Therefore the Gault appears to be unconformable to the Shanklin Sands.

As the Gault presents the same wedge-shape, that too probably thins off from a similar unequal depression of bottom; for within certain limits where the bottom is deepest, there will the thickest beds be formed. The fossils of the Ely Gault are like those found at its base elsewhere, and as Upper Gault is almost everywhere unfossiliferous, I suspect only the lower part is here, and that the Greensand rests unconformably upon it; and as already remarked, the beds do not pass into each other. Clearly it would not have been remarkable had these strata been wanting; and to me their presence indicates a shoal sea dividing the northern from the southern area.

The Shanklin Sands are the result of upheaval changing the rivers, and bringing old Palæozoic and granitic rocks into denudation. The Gault is a partial return to the old river condition of the Kimmeridge Clay. The Upper Greensand in this district is certainly a shore deposit, so there is now greater upheaval than ever. But the Chalk is the result not only of a depression of the Greensand sea but of the continent of which it was the shore.

II.—The Rocks and Minerals of Finland.

By George E. Roberts, F.G.S., F.A.S.L.

I OBTAINED last summer, through the kindness of my venerable friend, Dr. Nils Nordenskiöld, of Helsingfors, a fine collection of Finnish rocks and minerals, collected by his son, Professor Adolph Nordenskiöld, of the Academy of Science, Stockholm. Very little attention has been given in this country either to the rocks or mineral productions of this part of Northern Europe, although both are exceedingly remarkable. I propose, therefore, to introduce some of the more interesting in this article, giving at the same time a brief sketch of the general mineralogy of the land.

A privately-printed catalogue of the various minerals found in Finland by Dr. Nordenskiöld lies before me. I find it to contain, including some recent MS. additions, 175 varieties. These are arranged under the following heads:—Haploiten, i.e. elementary minerals in a native state; Diploiten, those having two elements; Bidiploiten, those which are compounds of any two minerals of the last-named group; Tridiploiten, Tetradiploiten, and Pentadiploiten, groups composed respectively of minerals which consist of combinations of three, four, and five of the Diploiten integers. Lastly, a group of minerals the composition of which has not been satisfactorily ascertained.

Among minerals of the first group, graphites are prominent. My specimens of this carbonaceous mineral show it as brilliant scales, or in minute folded leaves upon the surface of calcareous spar, in pleasing association with pale-green apatite, black crystals of pyroxene, and the orange-yellow mineral known as chondrodite. Ersby in the Pargas district is its best locality—a locality which has yielded some of the rarest of Finnish minerals. Crystals of a graphite have also been met with at Ersby by Dr. E. Nordenskiöld, and pronounced by *him* monoclinic, the form obliquely tabular, not unlike common mica.

Gold, in grains and dendritic filaments, is met with at Kemi and Kuusamo. Native copper is produced in three localities—Orijärwi, Mäntuwaura, and Pitkäranta.

The minerals classed under the second heading are not represented by fine or important specimens. Zinc-blendes and molybdenas are in this classification necessarily associated with quartz in its simplest forms of rock-crystal, amethyst, rose-quartz, milk-quartz, &c., but the crystals of these do not attain the dimensions or the brilliancy which distinguishes them elsewhere in Europe, as at St. Gothard, Oberstein, and Dauphiny.

Minerals which are combinations of any two of the last sections are better illustrated in Finland. Among these are the two rare columbates of iron, tantalites, and ixiolite (which also contains 12·79 of oxide of tin): these are all met with in albite-granite, at Kimito, Tamela—where there are great iron mines—and other places. Gahnite, a spinel containing oxide of zinc, well known to us as occurring in the lavas of Vesuvius, occurs in well-defined and brilliant crystals at Kisko, Lojo, and Helsingfors; true spinel at Sibbo and Lojo; tetraphyllin and pyrallolite, an altered magnesian form of pyroxene, at Pargas; scheelite, a tungstate of lime, at Pitkäranta; staurolite, a silicate of alumina which has been artificially produced by the chemist, in fine crystals at Imbelax; kyanite, with a delicate blue blush, at Pielisjärwi (this mineral is sometimes passed by jewellers as the sapphire); zircon, which when found in small brilliant grains or crystals is popularly known as hyacinth, at Ojämo Eisengrube in Lojo; cymophane, an opalescent yellowish-green chrysoberyl, one of the latest of Dr. Nordenskiöld's discoveries, at Ulrikasborg, near Helsingfors, where it occurs in a coarse granitoid garnet-bearing schist; marmolite, a pale-green waxy-looking variety of serpentine, from Tornoå; frugardite, an idocrase, from Frugard; and tetraphylline, a rare anhydrous phosphate of iron, associated with the semi-transparent variety of tourmaline, known as indicolite, from Tammela.

The tridiploiten section naturally includes fewer minerals. Among them are apatites, gypsum, meerschaum—not, however, the pure light material from which our pipe bowls are made, but a soft earthy serpentine—wittingite from Storkyro, for which rare substance Dr. Nordenskiöld propounds the formula:—$2\,(\dot{Fe} + 9\,\overset{\cdots}{\bar{M}}n)\,Si + 3\,\dot{H}$; and degerite, $\ddot{Fe}^2\,\dddot{Si}^3 + 6\,\dot{\bar{H}}$, $\dot{Fe}^3\,\overset{\cdots}{\ddot{P}}$, from Helsingfors.

Minerals which are quaternary combinations are a more numerous and varied class; comprising many of great variety, and several which are nearly unknown in England. Of such I may mention pitkarandite, in fine leek-green crystals, from Pitkäranta, an augitic minèral called by Scheerer 'a paramorphic amphibole,' a fine specimen, showing the form of the crystals; Steinheilite, a pale violet-coloured iolite, which may differ but little from dichroite, in amorphous masses veined with sulphuret of copper, from Orijärwi, Åbo, and elsewhere; the curious coal-black hornblendic mineral sordawalite (also met with, green), from Sordawala, where it occurs as thin layers in trap; 'smaragds,' rough beryls, in crystals five to seven inches in length, from Tammela, Kimito, &c., also met with, more rarely, in pale-green and blue transparent crystals (precious beryl), at Tammela; tourmaline of *excessive* brilliancy in albite, at Imbelax—an excellent group of crystals; a large group of hornblendic minerals, conspicuous among which is pargasite, occurring in semi-transparent leek-green nodules, set like plums in a pudding of calcareous spar, associated with jet-black 'plums' of hornblende, crystals of sphene of vivid brightness, containing titanium, shining scales of yellow glimmer, dioptase, graphite, and garnets of almost every kind. One specimen exhibits pargasite in association with four of these minerals. The plums of pargasite have a worn rolled-up appearance, and are in many instances full of air-cavities. This interesting mineral with its associates occurs most abundantly at Pargas. In this district of Finland, minerals belonging to the pyroxene group, such as sahlite, coccolite, diopside, bronzite, malackolite, and funkite are met with. The garnet family is well represented. Almandines, the aristocracy of the tribe, occur at Åbo, Imbelax, and three other places; the richly-coloured Romanzowites occur at Pargas and Kimito; chondrodites, red, black, and transparent-yellow, are contributed by Lojo and Pargas; iwaarite $(\dot{\mathrm{Ca}}_3\,\dddot{\mathrm{Si}} + \overline{\dddot{\mathrm{Fe}}}_2\,\dddot{\mathrm{Si}}) + \dot{\mathrm{Ca}}\,\ddot{\mathrm{Ti}} + 2\,\dot{\mathrm{Ca}}\,\dddot{\mathrm{Si}})$ by Kuusams; and jewreïnowite, scarcely less rare, having the formula $3\,(\dot{\mathrm{Ca}}, \dot{\mathrm{Na}}, \dot{\mathrm{K}})\,\dddot{\mathrm{Si}} + \overline{\dddot{\mathrm{Al}}}, \overline{\dddot{\mathrm{Fe}}})\,\dddot{\mathrm{Si}}$, from Manzälä. Rocks of the felspathic group are plentifully distributed throughout Finland; white and flesh-coloured albites too are common, with their ordinarily imbedded minerals. White albite, it may be remembered, is the mineral associated with felspar in Pompey's pillar.

In section five we meet with some rare altered forms of iolite, chief of which is gigantolite, in large crystals of a dark shining steel-grey in gneissoid granite, at Tammela, and pyrargyllite, a dull-brown mineral, infusible before the blow-pipe.

In the last group, comprising the minerals the exact composition of which is undetermined, we may mention thermophyllite, a silicate of magnesia, occurring in small silvery-white crystals in a steatite-like base, which is probably the same mineral in an amorphous state; sundvikite, probably an altered anorthite; and a curious black copper from Pielisjärwi.

III.—DESCRIPTIONS OF SOME NEW EOCENE SPECIES OF CYPRÆA AND MARGINELLA.

By FRED. E. EDWARDS, F.G.S.

(PLATE XIV.)

SINCE the publication by the Palæontographical Society of the third part of my monograph of the '*Eocene Mollusca*,' containing descriptions of the several Eocene species of *Cypræa* then known, I have obtained from the beds in the New Forest, forming parts of the Bracklesham Bay series, several additional species; and Mr. Wetherell has also been so fortunate as to obtain another remarkably fine species from the cutting lately made near Highgate for the Highgate and Edgeware Railway. I now forward descriptions of these new *Cypræa* for publication in 'THE GEOLOGICAL MAGAZINE;' and I avail myself of the same opportunity to correct an error committed by me in the same part of my monograph, in referring to *Marginella pusilla*, a species described by me from High Cliff, a small *Marginella* from Headon Hill, which I now propose to separate under the specific name *æstuarina*.

1. CYPRÆA CAVATA (F. E. Edwards): Plate XIV. fig. 1 a—d.
C. testá globosá, anticè attenuatá, levi: spirá prominulá, sulco obscuro circumdatá; aperturá angustá, obliquá, elongatá, leviter arcuatá, ad utramque extremitatem emarginatá; labro compresso, incrassato, regulariter dentato, extùs marginato, anticè depresso, cavato; labio plicato-dentato, anticè in callum fastigiosum ad basin tendentem lateraliter expansum, posticè in callum producto; plicâ anticâ magnâ, proeminenti.

Shell globose, attenuated in front, smooth: spire apparent but of almost concealed by the enamel, and circumscribed by an obscured furrow, due to the suture. The mouth is narrow, oblique in the middle, curved, and produced at each end into a short, moderately wide canal slightly notched: the outer lip, which is somewhat flattened on the front surface and thickened externally, presents on the inner edge a series of teeth of which the anterior four or five are longer than the others; towards the anterior extremity it is flattened and a little hollowed out. The inner lip bears a row of pliciform teeth, regular and transverse—except the front one, which slants upwards, extending across the whole width of the inner lip—and is prominent, rounded, and bifurcate at the point where the anterior canal commences, the left-hand margin of which is formed by the prolongation of the right furcation. The front part of the inner lip, like that of the outer lip, is flattened and hollowed, and is enlarged laterally, so as to form a ridge-like callus extending to the base. The posterior extremity is produced into a bluntly-rounded prominence, which forms the left wall of the posterior canal. The roundedly hollow depressions towards the front of the lips, and from which the specific name is taken, form a spoon-like trough resembling that found in *C. oviformis* (Sow.) and *C. Bartonensis* (Edw.).

In the young state (fig. 1 a, b) this *Cypræa* much resembles an *Ovula*. The surface is covered with numerous wavy shallow furrows, finely decussated by the lines of growth; the aperture is very effuse in front, and the posterior canal scarcely curved.

The *C. cavata* approaches so closely to *C. angystoma* (Desh.) that, at first sight, it might be taken to be a local variety of that species; but on closer examination differences appear sufficiently marked to render a separation necessary. In the present species the shell is more globose and less attenuated in front than in the French shell; the aperture is less curved, the anterior and posterior canals are wider, and the callus at each extremity is thicker and more prominent than in *C. angystoma.* A *Cypræa* is found in the lower Oligocene formation at Latdorf (*C. sphærica*, Phil.), to which our English shell also presents a close resemblance; but in the German species the shell is more attenuated in front, and does not present the spoon-shaped depression which characterises *C. cavata;* it is besides much smaller.

Size: In the figured specimen, in the direction of the axis, 1 in. 11-12ths; diameter, 1 in. and 5-12ths; but a specimen from Hunting Bridge has attained a length of 2 in. and 1-12th.

Localities: Hunting Bridge and Bramshaw in the New Forest (Mus. Edw.).

2. CYPRÆA ALATA (F. E. Edwards); Plate XIV. fig. 4 a, b.
C. testâ ovato globosâ, antice attenuatâ, lævi: spirâ omnino obtectâ; aperturâ latiusculâ, arcuatâ, antice paulo effusâ, ad basin emarginatâ; labro regulariter arcuato, in medio compresso, postice producto, edentulo? labio dentato-plicato.

Shell oviform, ventricose, smooth, presenting on the posterior portion of the lower surface a few sharp, irregular, transverse elevated lines, a character generally indicative of an immature state: the spire is entirely concealed. The aperture is moderately wide, curved, a little effuse in front, and broadly but not deeply notched at the base. The outer lip is regularly curved, somewhat flattened on the inner surface, and prolonged and much bent at the posterior extremity, where it forms, as it were, a wing-like enlargement, from which the specific name is taken. The specimen under description does not present any trace of teeth on the outer lip; but it may be an immature specimen, and I hesitate therefore to rely on its edentulous condition as a specific character. The inner lip presents a series of irregular pliciform teeth, which become almost obsolete towards the posterior extremity.

In general character and appearance this *Cypræa* presents a resemblance to *C. Levesquei* (Desh.); but, judging from the figure given by Deshayes, it is more globose than that shell, and not so much attenuated in front: the aperture, also, is more curved and wider, and the outer lip is altogether edentulous.

This remarkably fine Cowry forms part of Mr. Wetherell's valuable collection.

Size: In the direction of the axis to the end of the outer lip, 2 in.; diameter, 1 in. and 4-12ths.

Locality: Highgate, where it was obtained from the cutting for the Highgate and Edgeware Railway (Mus. Weth.).

3. CYPRÆA ORTHOCHEILA (F. E. Edwards); Plate XIV. fig. 2 a, b.
C. testâ ovatâ, ventricosâ, antice attenuatâ, lævi: spirâ obtectâ; aperturâ elongata, latiusculâ, rectâ, ad basin paulo effusâ, postice subcanaliculatâ; marginibus regulariter dentatis, denti-

bus numerosis, sub pliciformibus; labro extûs sub-marginato, postice producto, fortiter arcuato.

Shell egg-shaped, ventricose, attenuated in front, smooth: spire concealed. The aperture is elongate, straight, moderately wide, slightly effuse at the base, and obscurely channelled behind. Each margin presents a row of numerous regular, narrowish, rather fold-like teeth, nearly equal; the anterior teeth being somewhat more lengthened than the others. The outer lip is thickened, flattened on the inner surface, and the posterior extremity produced, and rather suddenly and strongly curved.

The only specimen of this *Cypræa* I possess is in an imperfect state; but the remarkably straight and suddenly curved outer lip is a character which entitles it to specific distinction, and justifies the present description.

It presents some resemblance to *C. inflata* (Lam.); but the peculiar condition of the aperture and the outer lip, and the absence of the small elevated callus found at the posterior extremity of the inner lip of the shell in that species, sufficiently distinguish the present species.

Size: In the direction of the axis, 1½ in.; diameter, 1 in. and 1-12th.

Locality: Brook in the New Forest (Mus. Edw.).

4. Cypræa attenuata (F. E. Edwards); Plate XIV. fig. 3 a, b.

C. testâ globosâ, antice valde attenuatâ, lævi: spirâ omnino obtectâ; apertura angustâ, elongatâ, flexuosâ, ad utramque extremitatem emarginatâ; labro incrassato, marginato, antice compresso, intûs regulariter dentato; labio plicato dentato, antice in callum fastigiosum ad basin tendentem elevato, postice in callum transversum producto.

Shell globose, somewhat produced and much attenuated in front, smooth; spire altogether hidden by the enamel. The aperture is flexuose, narrow, equally wide along the whole length except towards the base, where it is somewhat contracted by the ridge forming the termination of the inner lip. At each extremity it presents a short canal rather broadly but not deeply emarginate. The outer lip is much thickened and spread out, forming a raised margin, broad in the middle and at the posterior extremity, but narrowing towards the front. It is much flattened on the anterior inner surface, and the inner edge presents a series of regular pliciform teeth, which gradually decrease in size as they approach the posterior extremity. The inner lip is furnished with a row of teeth, prominent in front, small and obscure on the middle and posterior extremity. In front the lip expands into a narrow, ridge-like prominence, extending to the base, and at the posterior extremity it rises into a sharpish, transverse ridge, which forms the left wall of the posterior canal.

Size: In the direction of the axis, 8-12ths of an inch; diameter, 5-12ths.

Locality : Bramshaw (Mus. Edw.).

5. CYPRÆA TUMESCENS (F. E. Edwards) ; Plate XIV. fig. 5 a—c. *C. testa ovato-globosâ, antice rostratâ, lævi : spirâ obtectâ ; aperturâ elongatâ, angustâ, antice late non profunde emarginatâ, postice sub-canaliculatâ ; labro leviter arcuato, compresso, postice producto, regulariter dentato ; dentibus numerosis, pliciformibus ; labio* ?

Shell smooth, ovate, tumid, much and rather suddenly attenuated, so as to form, as it were, in front a perspicuous beak, broadly but not deeply notched at the base ; spire concealed. The aperture is narrow, produced posteriorly into an obscure moderately-wide canal. The outer lip is slightly but regularly curved, flattened on the face, produced at the posterior extremity, where it is suddenly bent so as to form the posterior canal, and presenting on the edge a row of rather numerous, nearly regular, pliciform teeth, which extend over about a half of the flattened surface of the lip, and of which those towards the front are the smallest. The inflected posterior extremity is thicker than is usually the case, and the lip itself terminates in front in a strong oblique fold, which forms the right wall of the anterior canal. The interior of the specimen figured is, unfortunately, so much crushed that the condition of the inner lip cannot be satisfactorily made out ; but the lip presents at the anterior extremity three oblique folds, of which the front one forms the left wall of the anterior canal; and this character is also found in another specimen (fig. 5 c), a fragment showing the condition of the outer lip and the anterior canal.

The present *Cypræa* presents a close analogy with *C. globularis* (Edw.) ; but in that species the shell is more globose, and less produced anteriorly. The aperture is more effuse, the outer lip not so much produced at the posterior extremity, and the inner lip is without the anterior folds found in this species. The nearly regular ovate form, and the condition of the teeth on the outer lip, of the shell in *C. Bowerbankii* (Sow.), distinguish *C. tumescens* from that species.

Size : In the direction of the axis, a little more than 1 in. and 7-12ths ; diameter, 1 in. and 1-12th.

Locality : Brook, Bramshaw (Mus. Edw.).

6. CYPRÆA CANCELLATA (F. E. Edwards); Plate XIV. fig. 6 a—c. *C. testâ oblongo-ovatâ, sub-cylindraceâ, lineis elevatis transversis striisque longitudinalibus sese decussantibus ornatâ : aperturâ elongatâ, angustâ, leviter arcuatâ, antice vix emarginatâ ; labro extûs submarginato, intûs regulariter dentato ; labio antice plicato.*

Shell oblong-ovate, attenuated towards the base, but so slightly as to present a somewhat cylindrical character. The surface is ornamented with numerous elevated transverse and longitudinal raised lines, decussating each other, and giving to the shell the appearance of being covered with net-work. The transverse lines are prominent, regular, moderately distant over the middle and posterior parts, but more closely set towards the base; and they extend from the columella over the whole surface to the edge of the outer lip. The longitudinal lines are more numerous and more slender than the transverse lines. The aperture is elongate, narrow, slightly curved, widely but not deeply notched at the base, and prolonged posteriorly into a wide, short canal. The outer lip presents a series of teeth formed by the ends of the transverse lines; and the inner lip is furnished towards the front with four or five pliciform teeth, distinct from and more prominent than the teeth formed by the ends of the transverse lines.

The specimen figured is, I believe, unique, and is unfortunately somewhat crushed: the foregoing description, therefore, must be received provisionally. In the ornamentation the shell closely resembles *C. elegans* (Defr.), except that it does not present the fine lines which most frequently intervene between the prominent transverse lines on the French shells; and it is apparently more cylindrical and not so much attenuated in front: the aperture also is more regularly curved, and the pliciform teeth on the inner lip are distinct in character and less numerous than those on the inner lip of the shell *C. elegans*. In form the present shell more closely resembles *C. sulcosa* (Lam.), but it appears to be wider at the base, and the ornamentation is quite distinct. A more perfect specimen may lead to the conclusion that the English shell is merely a variety of *C. elegans*.

Size: In the direction of the axis, rather more than 6-12ths of an inch; diameter, 4-12ths.

Locality: Bramshaw (Mus. Edw.).

7. Marginella æstuarina (F. E. Edwards); Plate XIV. fig. 7 a—c. Marginella pusilla (Edw.), Eocene Mollusca (Gasteropoda), p. 143, t. 18, f. 6, in parte.

M. testâ minimâ, ovali: spirâ brevissimâ, sulco obscuro circumdatâ; apice obtuso: aperturâ elongatâ postice angustâ, antice effusâ; ad basin latiusculo non profunde emarginatâ; labro submarginato, intûs crenulato; labio quinquies vel sexies plicato; plicis duabus anticis proeminentibus, obliquis; cæteris transversis, fere obsoletis.

Shell minute, oval; spire very slightly elevated, and circumscribed by a shallow sulcus almost obliterated by the enamel; apex obtuse. The aperture elongated, narrow behind, effuse and rather widely but not deeply notched in front: outer lip thickened along the outer margin, and very finely crenulated within. The inner lip presents two thick, prominent, oblique folds in front, and three or four transverse folds, almost obsolete, behind.

Since the publication by the Palæontographical Society of the third part of my monograph of the Eocene Mollusca, in which I referred the present species to *Marginella pusilla*, a High Cliff species, I have obtained several additional specimens as well from Headon Hill as from other synchronous deposits, and a more rigid comparison has induced me to separate the Headon Hill shells from the High Cliff species. The *M. æstuarina* is, in fact, distinguishable from

M. pusilla **by the shorter spire, the more depressed apex, and the condition of the folds on the columella. It is besides a broader and smaller shell.**

Size: Axis, 3-24ths of an inch; diameter, 2-24ths.

Localities: Headon Hill, Lyndhurst, and Roydon in the New Forest (Mus. Edw.).

EXPLANATION OF PLATE XIV.

Fig. 1. *Cypræa cavata* (F. E. Edw.).
  a. Back view of immature shell from Hunting Bridge.
  b. Front view of do. do.
  c. Back view of adult shell from Bramshaw.
  d. Front view of do. do.
2. *Cypræa orthocheila* (F. E. Edw.).
  a. Back view of adult shell from Brook.
  b. Front view of do. do.
3. *Cypræa attenuata* (F. E. Edw.).
  a. Back view of adult shell from Bramshaw.
  b. Front view of do. do.
4. *Cypræa alata* (F. E. Edw.).
  a. Back view of adult (?) shell from Highgate.
  b. Front view of do. do.
5. *Cypræa tumescens* (F. E. Edw.).
  a. Back view of adult shell from Brook.
  b. Front view of do. do.
  c. Fragment showing the condition of the outer lip and the anterior canal.
6. *Cypræa cancellata* (F. E. Edw.).
  a. Enlarged view of portion of the whorl, showing the cancellation.
  b. Back view of adult shell from Bramshaw.
  c. Front view of do. do.
7. *Marginella æstuarina* (F. E. Edw.).
  a. Shell natural size, from Roydon.
  b. Enlarged back view.
  c. Enlarged front view.

IV.—ON CERTAIN TRACKS IN THE MANX SLATES.*

By THOMAS GRINDLEY, Esq.

IN 1862 Mr. John E. Taylor (of Norwich), while surveying a newly-opened slate quarry at Dalby, on the western side of the Isle of Man, discovered three impressions of an oval form about nine inches long, and described them † as resembling the tracks of *Protichnites*, figured in Owen's Palæontology ‡; the quarrymen told him that they were of frequent occurrence.

In 1863 Mr. Grindley noticed similar markings in great abundance upon a series of beautifully rippled slates of Cambrian age at Laxey, on the eastern side of the island.

The outline of the markings is an irregular oval. Their dimensions vary considerably in different examples, the average size being

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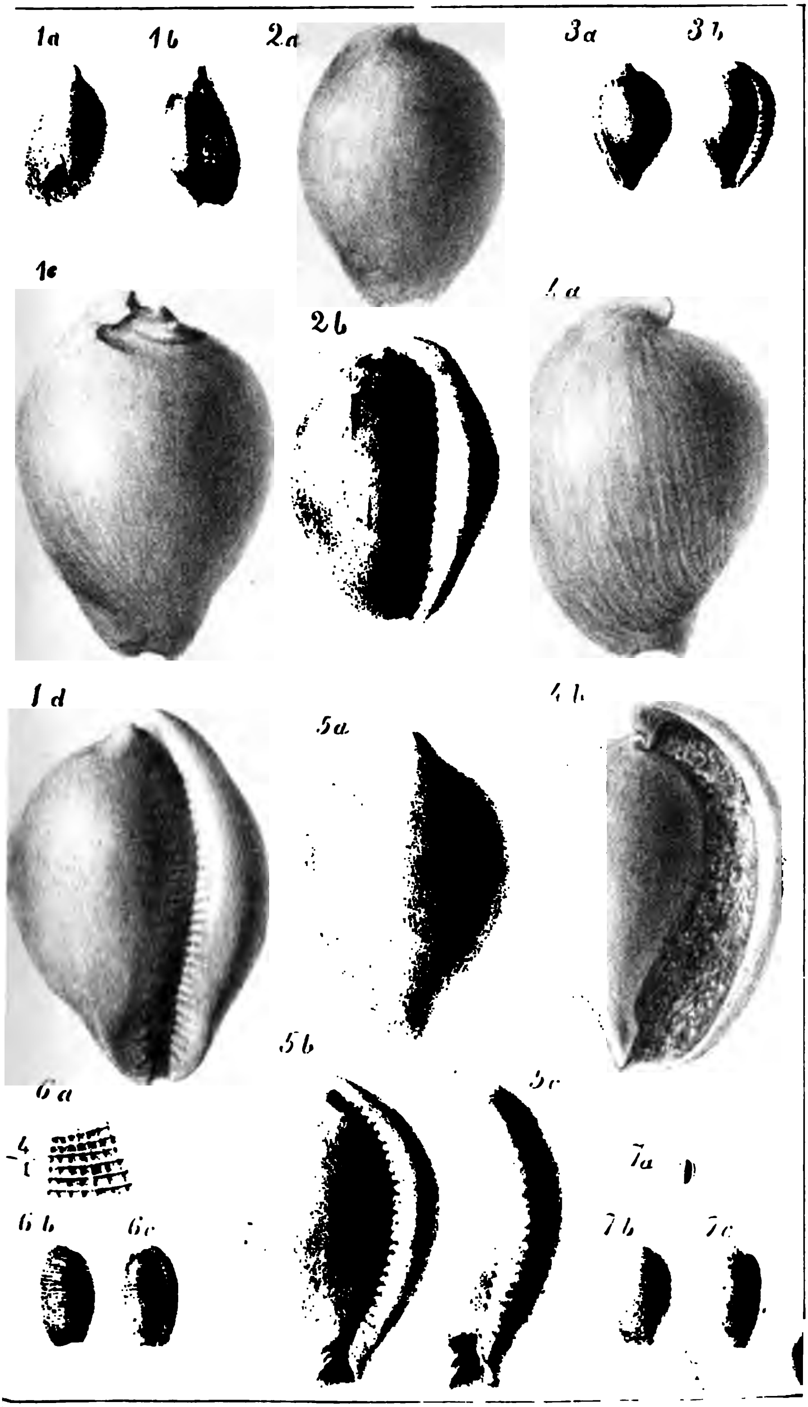
* This communication was received some time since, but from want of space we have been unwillingly compelled to postpone it, and even now cannot give it in full.—EDIT.

† Geologist, vol. v. 1862, p. 322.

‡ 2nd edition, 1861, p. 183.

Geol. Mag. 1865 Pl. XII.



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EOCENE SPECIES OF CYPRÆA & MARGINELLA.

eight or nine inches long, five or six inches wide, and two inches deep: in one instance the length was two feet, but only eight or nine inches broad; and from a crack running obliquely across the cast near its centre, Mr. Grindley concluded that it was not one cast but two, one partly overlying the other. The shape of the casts is always the same, independently of their being of different sizes; their mineralogical composition, though identical, or very nearly so, with the matrix, is generally much softer, and they are often washed out of the rocks that lie between high and low water. The casts are strongly coloured with iron, and frequently studded with small crystals of Blende (the neighbouring rocks contain this mineral in great abundance), which, when these crystals happen to fall out, present a very curious pitted appearance. The impressions, as a rule, occur in pairs, but a single one is often found by itself: when however they are in odd numbers, the missing one may be presumed to have been covered up by the neighbouring overlying rock, or else lost through a break in the continuity of the marked surface. They are generally of very unequal size; and the distance between the impressions is not always the same, but this is not to be expected when the great difference in the size of the pairs is considered. In some cases they touch each other; in others they are separated by an interval of several inches. The smallest impressions are usually closest together; occasionally the groups are clustered in great numbers, at other times scattered over the rocks very sparingly.

The larger axes of the impressions all point in the same direction, which is generally speaking, parallel to the line of strike, also to the ripple-marks on the rock-surfaces, and consequently more or less to the ancient sea-margin.

Supposing these impressions to be footmarks of some huge Cambrian or Lower Silurian reptile, Mr. Grindley discusses the habits which the various situations and positions of the traces indicate, and which tend to prove that the creature resorted to the shore in search of food.

This paper, the author states, is rather to draw the attention of scientific men to the subject afresh, than to record his own notions and observations. He reviews the different opinions expressed by geologists as to their real nature; some have strongly asserted their organic origin, while others have as positively denied it. With respect to the latter, some have regarded the casts as mere concretions, others as simply pebbles enclosed in the rock: but the casts show no signs of concretion or crystallization, which would be inconsistent with the first supposition, and their regularity of order would dispose of the second. Others have regarded them as double worm-burrows, but there is not the slightest connexion between the casts, and they are not deep enough for such to be the case. Among those who admit their organic origin, some suggest gigantic mollusks, but this appears to be inadequate to explain the fact when their arrangement in pairs, their marked position, and their occurrence in rippled slates, an indication of a littoral deposit, is considered, and an examination of the casts themselves affords no support whatever to this conclusion. Again, they have been regarded as the trail of a crustacean, but the absence of a central track, and the varying relations of the different groups, seem to preclude this explanation, though the fact that a great proportion of the casts are sunk in the matrix obliquely to the plane of the rock, appears in favour of it. But the hypothesis, that they are footprints of some unknown reptile, although it has found but little favour amongst geologists, harmonises in Mr. Grindley's opinion with the facts of the case better than any other yet proposed, and he thinks no sound objection has as yet been advanced against it. The idea of a creature of vast size prowling along the margin of the shore in search of food agrees in every respect with the trails, the difference in the size of the two pairs of casts composing the group of four, may be the result of a difference in the size of the hind and fore feet. The variation in the impressions would indicate a troop of animals of different ages and sizes.

In conclusion, the author stated that, though he was certainly of opinion that the markings were of reptilian origin, yet he was by no means unwilling to adopt any more reasonable explanation.

ABSTRACTS OF FOREIGN MEMOIRS.

I. ON CALAMITE-FRUITS FROM THE SPATHIC IRON-ORE NEAR HATTIGEN ON THE RUHR. BY RUDOLPH LUDWIG,

(CALAMITEN-FRÜCHTE AUS DEM SPATHEISENSTEIN BEI HATTIGEN AN DEM RUHR. VON RUDOLPH LUDWIG. Palæontographica, vol. x. pp. 11–16. Pl. 2.)

THE fossil which formed the subject of this memoir was obtained from a bed of spathic iron-ore occurring near Hattigen on the Ruhr, and had already been referred by Dr. Lottner[*] (who sent it to the author for examination) to the genus *Cyathocrinus*. Dr. Ludwig, however, determined that it was referable to the vegetable kingdom, and consisted of the fructifying spikes of a species of Calamite; he gives the following description of it:—the fossil consists of shortly stalked fruit-spikes lying in a whorl round the stem, having a cylindrical form, contracted above and below. The spikes are about seven centimètres in length and one in thickness; they consist of a number of closely packed, broad, short, and sharply pointed bracts arranged in a coronal manner upon circular, radially ribbed discs, attached to the hollow jointed stalk, so that as many as fifteen bracts form together a crown-like body, whose teeth exactly touch the middle rib of the bracts above. In this manner as many as from 20 to 25 cylindrical chambers, superimposed on one another are formed along the central column; they are imperfectly closed at the exterior margin, and each one contains five bunches of spore-capsules attached to the central stalk. The arrangement and mode of attachment of these capsules are in the highest degree peculiar.

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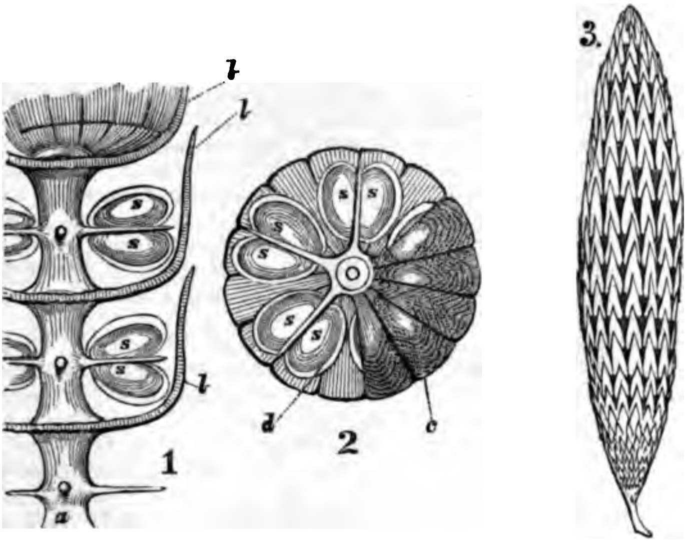
[*] Geognost. Skizze des Westphälischen Steinkohlengebirges. 1859, p. 154.

The spore-capsules themselves are in the form of a nut, or a flask, or an elongated egg, they have a strong shining shell, are nearly circular in transverse section, and have a scar on the inner end, which is somewhat bent, and thinner than the other. There are always four of these capsules arranged symmetrically round a short thorn-like stem, in a bladder-like integument. In each chamber five of such bunches are disposed round the central stalk, so that it contains 20 capsules. The thorn-like axes of the bunches are placed perpendicularly above those in the chamber below; they are hollow at the lower end, and are attached to short pegs projecting from the fibrous wood-substance of the central stalk.—H. M. J.



Structure of Fruit of Calamite.

Fig. 1. Vertical Section of part of Fruit-spike :—*a*. Axis of Spike; *b*. *b*., Bracts; *s*. *s*., Spore-capsules.

Fig. 2. Transverse Section of the same :—*c*. Floor of cell, partly removed to show Spore-capsules (*s*. *s*.) and integument (*d*).

Fig. 3. Entire Fruit-spike of Calamite.

II.—INTRODUCTION TO 'VESTIGES OF THE ICE-PERIOD,' BY L. P. HOLMSTRÖM.*

By Dr. Otto Torell.

IN the year 1836 Sefström published his memoir on the direction of the Ice-grooves in Sweden. He made very exact observations on the fact, scarcely noticed before, that the Swedish mountains are polished on the surface, and scratched or furrowed by some violent external agency. In order to explain this phenomenon and those connected with it, he supposed that a flood or deluge ("rullstens flod," literally "flood of the rolled stones") had overwhelmed all Scandinavia, passing from North to South, carrying along with it great quantities of stones and gravel, and that the subjacent mountains had been ground and furrowed in the direction of the current, 'just as a polished slab of marble is furrowed by sand grains that are pressed in a continuous straight direction on its surface.'

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* Translated and communicated by Magister Lindström of Wisby, Island of Gotland.

After having examined the vestiges of the glacial epoch, Dr. Torell embodied the results he had arrived at in an academical treatise, published in 1858 ('The Mollusk-fauna of Spitzsbergen'), and there described the facts which, in his opinion, prove that all Scandinavia was once covered by snow and ice. During the progress of these researches he was led to results which had not been expected when the above paper was written; and he could not find anything supporting them in previous papers. He did not then suppose that the ice which had covered the mainland of Scandinavia had stretched farther than the coasts and the nearest adjacent islands. He tried to explain this by the fact that, during the Glacial epoch, the land was higher than it now is, and the islands close to the shores must then have been united with the mainland.

It has been known, since the beginning of this century, that a large part of Northern Europe is, as it were, overstrewn with 'erratic blocks,' the origin of which all naturalists agreed to seek in Scandinavia. The general opinion then was, that these stones had been carried from Scandinavia on ice-floes, and then deposited on the bottom of the extensive sea supposed to have stretched from the White Sea to the German Ocean.

In a paper which Dr. Torell communicated last year to the Royal Academy of Sciences in Stockholm, he endeavoured to show that the hypothesis of such an ocean was contradictory to facts, and that the transport of the blocks resulted from the large continental ice-covering of Scandinavia having spread over all the region where the erratic blocks are found. He showed how the known fact, that the blocks from various parts of Scandinavia have a different distribution beyond that region, could only be explained by the theory of their transport on a coherent and uninterruptedly progressing ice-field. A necessary supposition in support of this explanation was, that Denmark during this period must have been united with Scandinavia, and the author tried to prove that supposition. Continued researches made it apparent that several minor epochs or divisions could be discerned in the great Glacial period:—

1. There are no facts which enable us to trace the extent of Scandinavian land-ice before it reached its greatest distribution. This extension may even now be determined by the boundary-line of the erratic blocks, and the period of its existence may be considered the first part of the Glacial period.

2. In the second epoch the mass of the ice was considerably diminished. The Russian Waldai heights were no longer transgressed,

but, through their opposition, gave the moving ice on the Russian side of the Baltic a direction from North to South. This is evident from the route taken by the Silurian and Devonian blocks from Eisland and Liffland, and by the direction of the grooves in the Russian provinces near the Baltic.

3. The third division begins with the continued decrease of the ice which now moved in the basin of the Baltic. Finland was probably still completely or partly covered with ice. The ice also filled the basin of the Baltic, but was in the East checked by the resistance of the Russian and German Baltic shores. Ice, in consequence of its plasticity, always moves in the direction of least resistance, so that it must during this period have followed the median axis of the Baltic; thence a considerable south-west deviation was caused, and numbers of blocks from the island of Gothland were carried to Groeningen in Holland and Jever in Oldenburg. The islands of Aland, Dags, Gothland, and Bornholm, as well as Faxö on Seeland, were grooved and furrowed in directions somewhat corresponding with that indicated. But it was not only the islands that were covered and polished; the thickness of the ice was evidently so considerable that certain parts of the mainland of Sweden were overwhelmed by that moving from the Baltic. Dr. Torell showed by the direction of the furrows in Upland and Sodermanland that they had their origin from the Baltic, not from the mountain-ridge between Sweden and Norway. He also supposed that the eastern part Scania had been covered by Baltic ice.

As Sefström's observations on Scania were insufficient, Mr. Holmström, exhorted by Dr. Torell, undertook the researches on the direction of the grooves in Scania, and the results seem to confirm the views of Dr. Torell. The prevailing direction of the furrows in Scania is from North-east to South-west.

4. The land-ice did not pass the confines of Scandinavia, but retreated more and towards the central mountain-ridge.

5. Then came the last epoch, when only the large mountain-valleys were filled with glaciers, the diminution of which may still be seen in the traces of their existence that they have left in their moraines. During this last epoch the present Scandinavia was depressed, or subsided, north of Scania; the Yoldia-clays and shell-banks were deposited, filled with the remains of a Glacial fauna now vanished. Our large lakes were changed into bays, where the animals of the Glacial sea lived. The land was again elevated, and the bays again became lakes, Professor Lovèn having discovered in them the remnants of a Glacial fauna.

6. As the elevation continued, the climate was changed to that now prevailing, and the present geological epoch began.

III.—GLYPTODON CLAVIPES.

THE COMPTES RENDUS, September 18th, records an interesting paper by Marcel de Serres on *Glyptodon clavipes*, an almost entire skeleton of which has been set up by him in the Museum of Comparative Anatomy in Paris. This is the most complete example yet seen in Europe. The head is entire, and is remarkable for its great vertical depth, nearly equalling the lateral measurement (as 37 to 40). This elevation of the head is principally due to the large size of the maxillary bones.

The cervical vertebræ indicate an abnormal and probably unique condition, some of the elements being absent. M. Serres remarks that such a condition is without analogy at the present day.

The persistence of the dental bulbs, the great size of the lower jaw, and the zygomatic arch, furnished with a strong spur which greatly increased the surface for the attachment of the masseter muscle, show that the *Glyptodon clavipes* was even better adapted than the elephant for a vegetable feeder.—E. F.

REVIEWS.

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I.—On some Foraminifera from the North Atlantic and Arctic Oceans, including Davis's Straits and Baffin's Bay. By W. Kitchen Parker, F.Z.S., and Professor T. Rupert Jones, F.G.S. 4to. 1865. (From the Phil. Trans. 1865, pp. 325–341. 8 Plates.)

THIS Memoir, communicated to the Royal Society by Professor Huxley, F.R.S., in 1864, has for its chief object the description of a certain group of Foraminifera, constituting the Foraminiferal portion of the fauna of a distinct Natural-history Province. Another object that the authors set before them was the careful discrimination of such forms, and groups of forms, among the Foraminifera as show strict zoological relationship, however much masked by dissimilarity of shape, but really recognisable by similarity of structure, among numerous puzzling gradations of equivalency, modified by varying conditions of growth, according to depth, saltness, and warmth of water.

The materials for the work were derived from (1st) Soundings in Baffin's Bay, made during one of Parry's Voyages; (2nd) Dredgings in Davis's Straits, among the Hunde Islands, by Dr. P. C. Sutherland; (3rdly) Dredgings on the Coast of Norway, by Messrs. MacAndrew and Lucas Barrett; and (4thly) Soundings in the North Atlantic, taken by Commander Dayman when exploring the Atlantic floor for the Telegraph-line.

Some of these materials belong to what Naturalists term the 'Arctic Province;' but the North Atlantic belongs chiefly to the 'Celtic Province,' and Captain Dayman's soundings supply illustrations of its abyssal fauna. Its littoral fauna on the east is to be found around the British Isles, and Messrs. Parker and Jones (with Mr. H. B. Brady's help) drew up a corrected list of the British Foraminifera for this part of their subject. The western, or American 'littoral' of the 'Celtic Province,' is called the 'Virginian;' and from this Dr. Bailey has figured and described some Foraminifera, which also are critically classified and made to serve as illustrations of the eastern bed of the great marine Province under discussion. Thus the whole Foraminiferal fauna is tolerably well represented, and careful Tables give the result; and it is curious to see how some forms love the deep and some the shallow—how some get large in going down from shore, and others become dwarf, thin, cut down, and otherwise aberrant when obliged to live high up in shallow water. Thus *Polystomella* and *Miliola* love the shore, *Globigerina*, *Pullenia*, and *Orbulina* thrive best at great depths (2,000 fathoms and more). A Table also shows how far the genera found in the 'Celtic Province' are distributed in certain parts of other seas and oceans; and Foraminifera from those places which are not found in the North Atlantic are also tabnlated, with indications of their relative size and abundance. Thus the Rhizopodist finds the Foraminiferal fauna (with the relative size and frequency of individuals) for altogether thirty-two spots in the Arctic, Atlantic (North and South), Mediterranean, Red Sea, Indian Ocean, and Pacific, by consulting the Tables in this Memoir.

The occurrence of many Foraminifera in the fossil state is recorded in the description of genera and species, forming the bulk of this Memoir; and we particularly direct the geological reader to the explanations of Plates XVIII. and XIV. (miscellaneous Foraminifera, illustrating either the very wide range of specific form, or some of the links between diverse forms), wherein several curious Tertiary (*Grignon*) species are described. The fossil Foraminifera of the Vienna Tertiary, known by the works of D'Orbigny, Reuss, and Czjzek, as well as Cretaceous and other species, are frequently alluded to, sometimes illustrated afresh by recent specimens, and put into their places in the new classification, which was begun by Williamson, and carried out by Carpenter, Parker, and Jones. It is a pity there is no index to the Memoir; but a palæontologist working at Foraminifera would find it worth while to make one for his own use.

Of course, the full description here given of the materials of the Atlantic floor is of great interest to the general reader; and after all the nonsense one sees in the 'literary' magazines of the day about the enigmatical 'shell-fish' which the popular writers seem to think they ought to believe in, it is pleasant to see really of what the long-talked-of 'ooze' really consists. Not but what Dr. Wallich in the 'Natural History Review,' and Professor Huxley in an Admiralty Report, gave proper accounts of it, as far as their examination of it had gone; but here we have a table of its constituents according to their per-centage; and we have faithful figures, by George West, of all the Foraminifera taking part in the formation of this wonderful marine accumulation of the minute shells or calcareous cases of Rhizopods living and dying at the bottom of the sea. *Globigerinæ* and *Orbulinæ* are the chief; *Planorbulina Ungeriana*, *Pulvinulina Menardii*, *Pulv. Micheliniana*, *Pulv. Canariensis*, *Nonionina umbilicatula* and *Lagena marginata*, appear to be their principal associates, but in very few numbers as compared with the first two, which sometimes make up 95 and 97 per cent. of the ooze !

We are much indebted to the authors of this interesting memoir for giving us, as it were, a new test, which the palæontologist may in many instances apply, to solve the question of the conditions of marine life in bygone ages of geologic time.

II.—THE COAL QUESTION; AN INQUIRY CONCERNING THE PROGRESS OF THE NATION, AND THE PROBABLE EXHAUSTION OF OUR COAL MINES. By W. STANLEY JEVONS, M.A. Cambridge: Macmillan. 1865.

THIS book is not a rival but rather a fitting partner to Mr. Hull's 'Coal-fields of Great Britain.' Whilst Mr. Hull looks on Coal as a purely geological matter, Mr. Jevons views it as within the domains of statistical and political economy, taking Mr. Hull as his guide in geology (p. xii.).

The truth of Mr. Jevons's statement (p. x.) that 'the writers who have hitherto discussed this question, being chiefly geologists, have . . treated it . . in a one-sided manner,' may be doubted. Surely there cannot be a question any side of which is without a geologist to argue for it. Mr. Jevons, however, clearly does not mean by the above passage to cast a slight on geological enquiry; for he says (p. 30) that 'if the science of geology had no claims upon our attention it would repay all the labour spent upon it many times over, by showing where coal may reasonably be looked for.' Perhaps, though the labour thus spent may be much greater than Mr. Jevons thinks, our author disagrees with former writers in thinking that 'there is not the least danger of our reaching any fixed limit of deep mining, where physical impossibility begins' (p. 40), and he points out a mistake of Mr. Hull's in over-estimating the increase of temperature in descending further into the earth (p. 42), but he looks forward rather to 'commercial impossibilities' in the cost of sinking and working deep pits, and shows that the price of best Newcastle coal has more than doubled in less than 100 years. But, in an able pamphlet on the 'Fall of the Value of Gold' (Stanford), Mr. Jevons has himself proved that there has been a rise in the prices of most things, and therefore the force of the above fact is somewhat lessened, although not enough to shake the conclusion that 'when with the growth of our trade and the course of time our mines inevitably reach a depth of 3,000 or 4,000 feet, the increasing cost of fuel will be an incalculable obstacle to our further progress' (p. 67); for even now 'deep mines are so deliberately opened . . . that the highest prices obtained are, taking all mining risks and charges into account, only an average equivalent for the capital invested;' moreover 'these deep pits can only be undertaken at present in search of coal of the finest household quality' (p. 66). Mr. Jevons combats the notion that by a more economical use of coal, through improvements in machinery, &c., the increase of consumption will be stopped or checked, and holds that 'new modes of economy will lead to an increase of consumption, according to a principle recognised in many parallel instances' (p. 103), such as the substitution of machinery for hand labour, the reduction of taxes, and low rates of profit, which have respectively tended to the increase of employment for workmen, to the increase of consumption of the articles taxed and the consequent addition to the revenue, and to the increase of business. 'The same principles apply, with even greater force and distinctness, to the use of such a general agent as coal. It is the very economy of its use which leads to its extensive consumption. It has been so in the past and it will be so in the future' (p. 104). Thus the steam-engine was hardly used at all for many years after its invention, on account of the large quantity of coal consumed; and it did not come into general use until Watt brought forward his inventions for saving heat, that is coal.

Our author also shows that we cannot look forward to finding any substitutes for coal, and remarks that 'if any wholly new source of power be some day discovered, we have no reason to suppose that our island will be as pre-eminently endowed with it as with coal' (p. 144).

Another reason for our looking forward to a great increase in the consumption of coal is that 'we do each of us in general increase our consumption. . . . The population has about doubled since the beginning of the century, but the consumption of coal has increased eightfold and more. The consumption per head of the population has therefore increased fourfold' (p. 150).

Having found that the average yearly growth of our consumption is 3½ per cent., and assuming this rate of growth to hold in the future, it follows that the increase will be from 83·6 millions of tons in 1861 to 2,607·5 millions of tons in 1961, and 'the total aggregate consumption of the period of 110 years, 1861—1970, would be 102,704,000,000 tons . . or in round numbers . . *if our consumption of coal continue to multiply for* 110 *years at the same rate as hitherto, the total amount of coal consumed in the interval will be one hundred thousand million tons.* Mr. Hull's estimate of the available coal in the kingdom, within a depth of 4,000 feet, is only 83,000,000,000 tons; and therefore '*rather more than a century of our present progress would exhaust our mines to the depth of* 4,000 *feet, or* 1,500 *feet deeper than our present mines*' (pp. 213-5)—a pleasing prospect truly! Of course, it matters little to Mr. Jevons's calculation whether Mr. Hull's estimate is a few thousand millions of tons too low or not.

Our author next shows most conclusively that it is absurd to think, or rather to dream, that when our coal is getting exhausted we shall be able to import coal from other lands to work our factories: 'about 1,200 colliers of the size of the Great Eastern would be required to maintain our present supplies only' (p. 225), and the cost of freight would be very heavy. Of course, the raw materials would then, as now, go to the coal-yielding country to be worked up; it is commercially impossible that we should import both coal and raw materials. This side of the question is strangely illustrated by 'the curious fact that about the end of the seventeenth century the iron manufacture to some extent migrated to Ireland. The woods of hat country were full of timber when those of England were nearly exhausted. *The trade at once followed the fuel in spite of a want of ore in Ireland. . .* Ireland became an iron exporting country' (p. 282).

To look to the things of our own times is more pleasant than to look forward with Mr. Jevons to those of the future. 'Of a total (yearly) produce of 136½ millions of tons (about the years 1858-60), 103 millions are produced by nations of British origin and language, and 80 millions are produced in Great Britain itself.' If too we can take a wide view of the now proud adjective, 'British,' and apply it to all men of our widespread race, we may look into the years to come with less sorrow than if we use it only for those who live in these islands; for though our coal-fields are far greater than all others in Europe, those of North America, which are all in the possession of men of Anglo-Saxon race, 'almost indefinitely surpass ours in extent, and it may be added, in contents' (p. 254).

Lord Stanley in a late speech at the meeting of the British Association at Birmingham, said, according to the 'Times,' that Mr. Hull had taken a sanguine view of 'the Coal Question,' and Mr. Jevons a desponding one. Let us hope that there may be a mean between them, and that Mr Jevons may be amongst the first to acknowledge it in a future edition. Meanwhile we commend this book to the notice, not only of geologists, but of statists and politicians, as a specimen of sound reasoning, though we think that value enough has not been given to those accidental circumstances which often turn up unexpectedly and produce unlooked-for results.

III.—THE MILLSTONE GRIT, ITS FOSSILS AND THE RELATION IT BEARS TO OTHER GROUPS OF ROCKS, MORE PARTICULARLY AS IT OCCURS IN THE BRISTOL DISTRICT, AND SOUTH-WEST OF ENGLAND GENERALLY. By Fort-Major THOMAS AUSTIN, F.G.S., &c. 1865. London: H. BAILLIÈRE. 8vo. Pp. 58; 5 Plates.

THE Memoir before us is intended to convey to Geologists the result of the author's observations on the Millstone Grit, as observed near Bristol and in the South-west of England.

Major Austin not only enters into the question of the relation which this formation bears to other strata above and below it, but also gives a list and descriptions, accompanied by figures, of the organic remains he has been so fortunate as to obtain.

This catalogue includes 47 species found in the Bristol area, about one-half of which (23) are Brachiopods, the remainder comprising 1 Gasteropod, 20 *Conchifera*, 2 *Crustacea*, and 1 Fish-remain.

Any information to be obtained concerning the 'Farewell Rock,' or Millstone Grit, will be acceptable to the Geologist, whilst the Palæontologist will desire to compare its fossil-remains with those from the same rock in other and distant localities.

The Carboniferous series of the South-west of England is generally considered as more typical than that of any other district, as in Gloucestershire and Somersetshire this formation, composed of sandstone grit, and conglomerate, attains a thickness of 2,500 feet with but very slight traces of coal. In the Midland Counties, on the contrary, as Derbyshire and Lancashire, and even still further north, it contains intercalated beds of shale, impure limestone, and coal, accompanied by a corresponding change in the fossil contents.

The character of this formation, as seen in the Flintshire Coal-field, Shropshire, has already formed the subject of an article in the GEOLOGICAL MAGAZINE for March 1865, p. 107. Mr. Prosser describes the Millstone Grit of this district as highly fossiliferous, but the specimens are not well preserved.

As to the thickness of the Millstone Grit at Kingswood Hill near Bristol, Mr. Handel Cossham has clearly demonstrated that this deposit belongs in reality to the Lower Coal-measures, and is there known as the 'Holmes Rock,'—an important evidence of the further extent in depth of the Bristol Coal-field. (See GEOL. MAG., No. IX., p. 110.)

After treating of the Millstone Grit, its climate, and origin, the author proceeds to describe its fauna :—'A very great proportion of the organic remains,' says Mr. Austin. 'obtained and figured in this contribution to its history, I believe are new in species, though but few of them are so in genera.' The number of new species *is* very remarkable (39 out of 47), and on this point we feel extremely doubtful, especially as the descriptions are exceedingly meagre, and the figures do not help us much more. We should almost incline to the opinion that some at least were established on fragments of well-known species which our veteran friend has failed to recognize.

The nomenclature is seriously at fault, and we strongly advise the author, in justice to himself, to undertake the revision of the specific names, and the figures of many of his new species also.

An account of the economic uses of the Millstone Grit, and some interesting remarks on the dip of the beds, are deserving of attention and perusal.

IV.—THE SILURIAN FORMATION IN THE PENTLAND HILLS. By G. C. HASWELL, Hon. Sec. G.S.E. Edinburgh: W. P. NIMMO. 1865. Pp. 47. 4 Plates.

ALL visitors to Edinburgh know the Pentland Hills, which, closing in the horizon to the south, contribute not a little to the beauty of the magnificent panorama which surrounds the capital of the North. They are composed chiefly of felstone and ash with coarse conglomerates, grits, and sandstones of the Upper Old Red Sandstone age. In these localities the underlying Silurian rocks come to the surface, and to one of these, the famous Habbie's How, beyond Carlops—the scene of Ramsay's 'Gentle Shepherd'—Mr. Haswell has devoted some attention. The results of his observations he read to the Edinburgh Geological Society, and has now published. We almost regret that he has hurried himself into print, for while the essay is a good one for a first in geology, it scarcely deserves to form a separate publication. We say not this in a fault-finding spirit, for the perusal of the paper has given us pleasure, and we are certain that experience and continued observation will give the author a position in science. But the determination of species is no easy work, and it is specially difficult with fossils; and those which form the subject of this paper are more than ordinarily so. Before one ventures to add new names, the whole matter should be thoroughly wrought up, else endless synonymy—the curse of systematic Natural History—creates endless confusion. We hope that this paper will incite (and it will certainly assist) local students to an examination of these beds, and that before long we may see—not a new edition—but a new work, in which Mr. Haswell will go more thoroughly and systematically into these very interesting fossil-remains. He has already obtained several new species; and from the materials collected, he considers the strata to be the representatives of the Ludlow and Wenlock deposits.

V.—STRATA IDENTIFIED BY ORGANIC REMAINS.

THE QUARTERLY JOURNAL OF SCIENCE (No. VIII.) for October contains, in addition to the usual Chronicles of Geology and Palæontology, an interesting article by Mr. Henry M. Jenkins, Assistant Secretary to the Geological Society of London, on 'Strata Identified by Organic Remains.'

'"Strata Identified by Organized Fossils," was the title of a well-known work by William Smith (in 1817), in which he illustrated his discovery that the numerous formations constituting the crust of the earth could be distinguished and identified by means of their embedded fossils.'

This grand generalization of the 'Father of English Geology' inaugurated the dawn of a new era in our science, and has necessitated the establishment of the sister science, Palæontology.

Mr. Jenkins relates the progress, step by step, of geological investigation, and tells how Edward Forbes, in 1846 (29 years after the publication of William Smith's celebrated work), announced that identity of fossils in strata geographically far apart, must lead to the inference that the beds were of *different*, not, as hitherto maintained, of the same age. But it appears this new doctrine did not produce any permanent effect, and another period (16 years) is passed, when Professor Huxley, in his Anniversary Address to the Geological Society, again brings this heterodox notion before its members, since which time, several of our younger Palæontologists, including the author of the paper, have given the idea its due weight in endeavouring to correlate distant deposits.

'The views of Geologists on this question must depend more or less on their belief in the origin of species by descent with modification, and from single specific centres.'

Mr. Jenkins proceeds with his case, stating, we think, fairly, the *arguments pro* and *con*, the doctrine of the migration and mutation of species in time and space, and illustrates his article with a plate of various species of *Trigoniæ*, *Olivæ*, *Volutæ*, *Eburna*, *Argonauta*, &c., which he cites as evidence of the migration of species in an Easterly and South-easterly direction that may probably have been going on, with intervals of recurrent variations, since the commencement of the Secondary epoch.

The author believes, 'that as the distance between the formations becomes greater, so does, *cæteris paribus*, the difference in age increase. In other words, Geographical Space and Geological Time have the same sort of correlation as Electricity and Magnetism; with apparently contemporaneous strata, a certain distance means a certain lapse of time, and as one varies so does the other.' Dr. P. Martin Duncan and Mr. Harry Seeley are cited as Geologists holding these advanced views; and we may add Mr. E. C. H. Day, of Charmouth, had prepared an able paper upon this subject, which was cut short in its reading and too briefly noticed, before the British Association this year at Birmingham.

We have seldom read a paper with the greater part of which we more cordially agree, and the subject of which we think is more deserving the attention alike of Geologists and Palæontologists.

VI.—MUSÉE TEYLER. CATALOGUE SYSTÉMATIQUE DE LA COLLECTION PALÉONTOLOGIQUE PAR T. C. WINKLER, HAARLEM, 1863—65.

THE Teyler Museum at Haarlem is a well-known institution, and, besides other interesting objects of study, contains a remarkable and valuable collection of fossils. Among the latter may be found numerous examples of the genus *Ichthyosaurus* described by M. Bronn; many species of *Pterodactyle* noticed and studied by M. Herman von Meyer; a fine head and other bones of the *Mosasaurus*, and also of a turtle, both from the Cretaceous strata of Maestricht, as well as the great fossil salamander long ago described as the *Homo diluvii testis* by Scheuchzer; besides there are some species of fossil fish described by Dr. Winkler in the "Memoirs of the Scientific Society of Haarlem."

The general collection of fossils, which consists of about 12,000 specimens, was for some time unarranged, the geological position and locality of many of them being unknown. During the last few years, however, owing to the zeal and industry of Dr. T. C. Winkler, this valuable accumulation of fossil forms belonging to the different geological periods, has been more systematically arranged, and the present catalogue is the result. It is published in three parts, forming an octavo work of 380 pages, well and carefully printed, and including the determination of the fossil species in the collection of the Palæozoic and Mesozoic periods. The author has availed himself of the recent works on Palæontology, and in a great number of instances has added synonyms to the species indicated. The catalogues of the two periods are systematically arranged.

After noticing the plant-remains, the fossil animals are catalogued zoologically, commencing with the lower forms of *Invertebrata* and terminating with the *Vertebrata.* Although conversant with modern works, the author in some instances retains a certain nomenclature not quite in accordance with the present opinions; it may, however, express his view of the subject. Thus he retains *Unio* for the Palæozoic genus now called *Anthracosia*, and places *Bellerophon* under the Pectinibranchiate family *Fissurellidæ*; retains *Ammonites* for species of Goniatite, and classes *Hippurites*, *Radiolites* and allied genera, under the *Rudistes*, or irregular Brachiopods, notwithstanding the valuable memoir by the late Dr. S. P. Woodward * on these forms, in which he clearly indicated their affinity to *Chama*, and classed some with that genus, as *Diceras* and *Requienia*, whilst on other forms he constituted the family of *Hippuritidæ* as *Radiolites*, *Hippurites*, *Caprinella*, *Caprina*, and *Caprotina.*

In the Trilobites Dr. Winkler has retained genera of Hawle and Corda as *Crithias*, *Staurogonus*, *Acanthogramma*, *Tetracnemis*, &c., which M. Barrande has since shown to be only different stages of growth of the curious genus *Sao*—a form which has been favoured with about ten generic and more than twenty specific names. However, the catalogue is a useful synopsis of the contents of the fossil collection of the Haarlem Museum.

REPORTS AND PROCEEDINGS.

GEOLOGICAL SOCIETY OF LONDON.—Nov. 8, 1865.—W. J. Hamilton, Esq., President, in the Chair. The following communications were read:—1. 'On the Submarine Forest-beds in Porlock Bay.' By R. A. C. Godwin-Austen, Esq., F.R.S., For. Sec. G. S.

The submerged forest of Porlock Bay has been briefly noticed by Sir. H. De la Beche, but has not been sufficiently described, inasmuch as it illustrates more clearly than the larger forests of Bridgwater Level or Swansea Bay the nature and order of the oscillations of small amount which have taken place at times shortly antecedent to the present, and which were classified by the author in this paper as follows:—(1) The formation of an angular detritus and its accumulation at lower levels; at this period the land was at its highest relative elevation. (2) Forest-growths established on the detrital beds just mentioned; the stumps of those forest-trees, some of which are of large size and great age, at present constitute the *Submerged Forest.* (3) Accumulation of freshwater mud (resulting probably from a depression of the land), by which the trees were killed. (4) Surface of water-plant growths on the mud-deposit, or nearly dry surface, on which the trees fell. (5) Area depressed below the sea-level, and sea-mud with *Scrobiculariæ* deposited. (6) Conversions of the surface into meadow-land at the level of the highest springs of the present day caused by re-elevation. (7) Shingle, heaped up on the meadow-land, and showing that the most recent change has been one of slight depression.

This succession of changes corresponds with that of numerous other localities in the West of England, and, as Mr. Godwin-Austen considered the angular detritus (1) to be the result of subaërial weathering, which took place over this area approximately contemporaneously with the deposition of the Boulder-formation in more northern districts, this Porlock submerged forest seems to fix a relative date for the rest, namely, as being subsequent to the Glacial Period. By this means, also, a relative date is arrived at for many of the raised beaches in the West of England, as of that near Baggy Point, where the old sea-bed, at an elevation of 60 feet, is covered by an enormous accumulation of angular debris; these raised beaches may therefore correspond in time to certain marine deposits, which, in Norfolk and Suffolk, next underlie the great 'Boulder formation.'

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* Quart. Journ. Geol. Soc., London: vol. xi. pp. 40—61.

2. 'On the Marine Origin of the "Parallel Roads" of Glen Roy.' By the Rev. R. Boog Watson, B.A., F.G.S.

After a brief description of these well-known 'Roads,' the author gave an analysis of the two principal theories that have been started to account for their formation, namely, the Ice-dam theory and the Marine theory. With regard to the first theory, Mr. Boog Watson stated his opinion that although it has some strong points, especially in respect of the coincidence between the levels of the 'Cols' at the glen-heads and those of the 'Roads,' yet on the other hand it is weak, inasmuch as the cause assigned is extremely local in its action, while the phenomena to be explained are very general and have a wide range,—terraces similar to those of Glen Roy occurring in Scandinavia and elsewhere. In the author's opinion, also, the ice-dam is impossible, and would be inefficient if possible; it would not be water-tight, and there is no place for it in the history of the Post-pliocene changes in Scotland. But he remarked that objections like these cannot be urged against the Marine theory, as the sea has been on the spot, and is able to perform the work required of it. At the same time the author admitted that the Marine theory is not free from difficulties, the chief being the perfection and horizontality of the 'Roads,' and their barrenness in marine organisms; and he concluded by suggesting some explanations of these apparent anomalies.

The following specimens were exhibited:—Specimens from Porlock Bay; exhibited by R. A. C. Godwin-Austen, Esq., F.R.S., For. Sec. G.S. A miscellaneous collection of recent shells and fossil remains; presented by Sir R. I. Murchison, K.C.B., F.R.S., F.G.S. New Cornish Minerals; exhibited by Bernard H. Woodward, Esq. Specimens of various Minerals; exhibited by G. E. Roberts, Esq., F.G.S. New Corals from Malta; exhibited by Dr. P. Martin Duncan, Sec. G.S. The new edition of the Greenough Geological Map was exhibited in the Meeting-room.

ANNIVERSARY OF THE NORWICH GEOLOGICAL SOCIETY.—On Tuesday evening, the second anniversary of the Norwich Geological Society was held at the Maid's Head Hotel. It had been intended to have formed an excursion to Bramerton, for the purpose of studying the Upper Crag, but the unfavourable state of the day prevented it. After tea, the Rev. John Gunn, President of the Society, occupied the chair, and, in his address, reviewed the work of the past session. It was not until he had prepared his notes of what had been done at the meetings in the shape of written papers, &c., that he was aware of the amount of real work which had been accomplished. He then proceeded to notice the fossil remains which had been discovered, or examined. Among these were the fresh-water shells at Thorpe, the discovery of shells in the middle drift at Saxlingham, various bones of deer from the Forest-bed, the tooth of a Mastodon at Horstead, &c. He then proceeded to notice the strata in which these organic remains were found. The interesting discovery by the Secretary of the singular contortions in the Whitlingham chalk (an account of which appeared in the GEOLOGICAL MAGAZINE for July last, page 324), was also mentioned. Mr. Gunn alluded, in feeling terms, to the loss of the late Dr. Woodward,* one of the members of the Society, and whose services were ever at the disposal of the members. Several papers were then read, the principal being one by Mr. Harmer, on the inland development of the drift beds near Cromer. The author followed the views of Mr. Searles Wood very closely, and ably defended them in the discussion which ensued. These views relate to the classification of the drift beds in the Easttern Counties. A very lively discussion ensued, during which Mr. Gunn gave a clear and succinct account of the manner in which the strata followed each other, and showed how they had been deposited. It was then proposed by Mr. Fitch, and seconded by Mr. King, that the Rev. John Gunn be re elected President of the Society. This proposition was carried unanimously. The remaining officers of the Society were also re-elected, and the company then separated.—*Norwich Mercury*, Oct. 28th, 1865.

BRITISH ASSOCIATION REPORTS.

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SECTION C.

I.—EXPLANATION OF A MAP OF THE FAULTS IN THE GOLD-DISTRICT OF DOLGELLY. By J. W. SALTER, F.G.S.

THE district examined includes roughly the course of the Mawddach River, as it flows from the twin waterfalls of Pistyll Cain, and the Mawddach Fall, and so down to the Barmouth estuary. This river runs chiefly through the softer lower division of the Lingula Flags, leaving a broad belt of the rocks north-west of Dolgelly; but almost obliterating and carrying them away along the lower reaches of the river. It is in this belt of rocks that the gold is won; and to all appearance the veins of that metal are only prolific along the line of junction of the Lower Cambrian, or Harlech Grits, and the black slates which form the mass of the 'Lower Lingula Flags.'

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* See Obituary, GEOLOGICAL MAGAZINE, August Number, p. 383.

Some major lines had been laid down in the mountain country to the east and south, and very accurately; but the faults along which the precious metals were won, and those which under the term of slides and cross-courses interrupted their work, were still for the most part to be put in.

Having laid down all the faults he could trace, the author found that they became systematic upon the map; and he was at length enabled to predict their occurrence by the contour of the ground, and to verify them by natural sections, with which the country abounds.

The author traversed a good deal of the ground from the Clogan mines on the west to Cefn Coch and Cwmheisian on the north-east; but finding that the faults were very numerous and complicated, he soon determined to contract the area of close observation to that in which his employer was most interested; and while he has maps of the fault lines observed all along the boundary, those only of Tyddyngwladis, Cwmheisian, and Gwynfynydd are laid down in detail.

He had no map to begin with except the Ordnance one-inch, and had to enlarge the Survey map four times its size during the course of his work. It is not even yet on a large enough scale.

The first thing was to correct the boundary line between the Cambrian and the Lingula Flags; and this could only be done by ascertaining the succession of the beds of the latter.

By this means it was found that the tendency of the main lines of fault—those which follow more or less accurately the trend or strike of the beds—was to repeat the series of beds; therefore there must have been upheaval and collapse of the Lower Cambrian nucleus. These great faults are joined by oblique and cross faults of no great regularity, but no doubt reducible to system.

Another set of faults of less dimensions, along the original strike of the country, and probably due to strain produced during that upheaval.

Along some of these faults and a third set at oblique angles (NE. and SW.) to them, the principal gold veins occur; while in one, which from its greater throw of the beds has probably been a second time faulted, a considerable vein of lead is found. They certainly cut off and shift the east and west veins.

These are crossed by a series of NW. and SE. faults, which in the Tyddyngwladis and Cwmheisian district and Dolfrwynog mines run parallel, and contain both gold and silver-lead.

And lastly, the whole are traversed by an important set of faults which shift all the others; and are undoubtedly the last, namely, true N. and S. faults, which run through the whole country—far away into the hills of Diphwys, and in fact as far as I was able to examine.

They give the features to the ground—steep cliffs, river courses, ledges, ravines, bluffs; all are defined by these master faults, which though seldom of any *very* great amount in the actual mining region eastward, become greater to the westward, and are, I suspect, of general import throughout the whole of Wales, if not much further.

In fact, this N. and S. set of faults, which no one seems yet to have noticed, is of chief importance in the whole of this mining district, cutting off the veins by repeated notches and slips, and in some cases dislocating them widely—e. g. Gwynfynydd. As soon as the existence and symmetry of these four lines of fault had been made out, the author's task became easy; the outlines of the country, at first so puzzling, leading one to them (on the rocky and uncovered hill sides) with great precision.

The North and South faults certainly bear copper, and have been worked at Dolfrwynog for that purpose, and also on the Bryniau Glo, further west on the Trawsfynydd Road.

The NW. and SE. faults were only traced in the narrow district above described. They are known to bear silver-lead, and gold in small quantities; and are next in point of age.

Then come the great strike-faults with their numerous parallel smaller faults, and cross-notches where they intersect the previous faults. These are not yet worked for metals.

The NE. and E. faults preceded these, and to all appearance the true E. and W. ones were earliest of all. These two are indeed the prolific veins for gold, and they have direct reference to the original elevation and ridging of the country. As they received their infilling of metalliferous deposits before the three subsequent, or at all events two of the subsequent systems of faults occurred, and are certainly the oldest set of fissures in the district, it is fair to infer that gold is one of the oldest minerals in Wales.

It is, of course, for the mining proprietors of the district to ascertain accurately what metals occur in each of these systems of veins, and by *much* further and closer search to carry out, complete, and correct the outline. The subject is of economic importance. It is well known that in Cornwall the mines of tin and copper run east and west in accordance with the strike of the rocks, while the lead veins cross these and run more in a N. and S. direction; and, again, that the tin veins are repeatedly crossed and shifted by copper lodes of a subsequent date; while both series have been again and again shifted by subsequent faults—as many as eight distinct systems of faults having been found in Cornwall and also in Germany, according to Sir Charles Lyell's latest account in his manual.

I have as yet only been able to make out four or five in the district in question, of which undoubteely the north and south lines are the newest.

That the relative ages of the various infillings of the metals may be ascertained by such research there is little doubt. But it must always be remembered that if lodes be faults, as they are, the second movement will often open the joints of the first, as along lines of greatest weakness; and hence there will be a mixture of metals in the older lodes which we need not expect in the newer. Accordingly, in the Dolgelly gold-lodes we find a mixture of Gold, Blende, *Silver-lead*, Iron, Arsenic, Copper, Sulphur, &c. And where cross-*courses* intersect the lodes, we may expect the more recent metal to be abundant, from the greater room, and also an interchange from subsequent redistribution.

I do not enter upon the great question of synchronism in parallel lines of disturbance suggested by Elie de Beaumont. The probability of its truth is too evident; but I call particular attention to the great N. and S. lines of fissure, which I am convinced have reference to a much larger area than Wales.

II.—NOTES ON THE POST-PLIOCENE DEPOSITS OF CANADA. By J. W. DAWSON, LL.D., F.R.S., F.G.S.

PART I.—ON THE RELATIVE AGES AND MODE OF FORMATION OF THE SEVERAL MEMBERS OF THE POST-PLIOCENE SERIES.—The marine Post-pliocene deposits of Lower Canada are, in descending order:—

1. The superficial sands and gravels, called by the author the 'Saxicava-sand.'
2. The underlying clay, named the 'Leda-clay,' otherwise known as the Champlain-clay.
3. The Boulder-clay.

These beds extend over a very large area, and rise to the height of 500 feet in the valley of the St. Lawrence. The author gives short descriptions of each of them. The Saxicava-sand is a shallow-water deposit, presenting the appearance of a succession of beaches and terraces; it has been much modified by marine and sub-aërial denudation. The Leda-clay is principally composed of material derived from the waste of the gray and red shales of the 'Quebec Group;' its characteristic fossil is *Leda truncata*, an Arctic shell not now inhabiting the Gulf of St. Lawrence. The Boulder-clay is associated with these deposits throughout their whole extent, and Dr. Dawson believes that it is not a continuous stratum occupying a special place in the Post-pliocene formation, but that it is entirely a marine deposit, indicating the local action of floating ice, and that its accumulation has been proceeding throughout the whole of the period of the Leda-clay and Saxicava-sand down to the present time.

Dr. Dawson gives examples of what he considers to be boulder deposits of different ages in Canada, which he classifies as follows:—

1. *Boulder-drift anterior to the Deposit of the Leda-clay.*—This contains fragments of Silurian and Laurentian rocks, and boulders often scratched and polished, and passes upwards into the Leda-clay at Montreal.

2. *Boulder-drift coëval with the Leda-clay.*—The Leda-clay, usually very fine and regularly stratified, occasionally contains large boulders presenting the appearance of having been dropped in, while it was accumulating, by melting ice, and subsequently buried.

3. *Boulder-drift of the Period of the Saxicava-sand.*—Though the Saxicava-sand is a littoral bed, and was formed in much shallower water than the preceding, yet it contains many boulders pro-

bably derived from fields of ice grounded in the shallows, and there depositing their rocky burden.

4. *Recent Boulder-drift.*—The driftage of the boulders in the Gulf of St. Lawrence was next noticed, and the author states that it would only require a subsidence which would bring these boulders under the influence of muddy deposits to form a sort of Boulder-clay.

5. *Supposed Drift by Glaciers.*—With regard to the striations on the shore of Lake Huron, &c., and in Labrador, referred to the action of land-ice by Sir W. Logan and Professor Hind, Dr. Dawson admits that the mean temperature of Canada may have been so reduced by the diminution of land surface and the influx of cold currents loaded with ice, to permit the existence of glaciers in some of the hilly regions; but he rejects the theory that Canada was at any time covered with a general or universal glacier as physically impossible, and assigns his reasons in a quotation from a previous paper, to the effect that most of the striations are due to icebergs, and that many of the so-called moraines are probably shingle beaches, and old coast lines loaded with boulders.

PART II. ON MODERN ICEBERGS.—This is an account of observations recently made on the icebergs in the Strait of Belle Isle. Between Newfoundland and Labrador, a branch of the Arctic current enters the strait at the north, bringing about one-fifth of the bergs that are drifted down the Labrador coast; as many as 496 bergs have been counted in the strait at one time, many 60 feet in height, some more than 200 feet. The bottom of the strait consists of rocks and stones in most parts; and as the majority of the bergs had grounded, it is evident that the abrading power exercised by them was enormous, far greater than that of any glacier in a single year. Other icebergs, 400 feet high and half a mile long, have grounded off the strait, which, urged on by the current, and swaying to and fro, would constitute abrading agents unequalled in power. One berg noticed by Dr. Dawson had been overturned, and displayed what had been its working surface flattened and scored. The author infers that no other agency than icebergs, reinforced by glaciers descending from the higher lands of Labrador, need be invoked to produce all the glacial effects observed in the Valley of the St. Lawrence, and that these observed phenomena correspond much better than that of a mantle of glacier, the possibility of which, on physical grounds, is more than doubtful.

PART III. ON THE POST-PLIOCENE PLANTS.—In this paper, Dr. Dawson describes the species of plants found in the Post-pliocene deposits, and shows what light they throw on the climate and geographical conditions of the period. They were principally obtained from nodules in the Leda-clay, associated with *Leda truncata*, and seem to have been washed down from the land into deep water. They indicate a summer colder than the present, to an extent equal to about 5° of latitude, which concurs with the other evidence the author has obtained, that the refrigeration of Canada in the Post-pliocene period consisted in a diminution of the summer heat, and was of no greater amount than that attributable to the depression of the land, and the different distribution of the ice-bearing current.

III.—The Pre-Cambrian Rocks of Central England. By Harvey B. Holl, M.D., F.G.S.

In this communication the author discussed the age of the metamorphic rocks which form the narrow ridge of the Malverns, as also those smaller protrusions which pierce the Cambrian rocks and Keuper marl of Charnwood Forest. In their profoundly altered aspect, in the similarity of their felspar, in the prevalence of hornblende as one of their ingredients, and in their general deficiency in free silica, the metamorphic rocks in both these localities, though separated by a distance of 60 miles, have nevertheless a character in common. In both, the dominant trend of the beds is from SE. and NW. to E. and W., and the foliation of the rock, where not obscured or obliterated, corresponds with the plane of the bedding. In the Charnwood Forest district, more especially, the rock is massive and even the bedding often effaced. In the great quarries of Mount Sorrel the rock is entirely granite, traversed by trap dykes, and remarkable inasmuch as it contains masses, varying in size from a walnut upwards, of finer grained and otherwise dissimilar rock. In evidence of the great antiquity of these rocks, it was shown that their metamorphism and uplifting into highly-inclined positions, and their subsequent invasion by augitic trap dykes, were all events which had happened previous to the deposition of the oldest overlying deposits. In the Charnwood Forest area these latter were stated to be of Lower Cambrian age, about which the author had no doubt, and they are laid down as such in all our geological maps; and admitting this, there can be no question respecting the prior age of the metamorphic rocks, vertical beds of which appear beneath the Cambrian strata, which rest upon them unconformably. In the Malvern district the oldest overlying rocks were referred to the age of the Middle Lingula flags, which rest unconformably on the gneissic rocks of the hills; and in the shallow-water conditions under which their lowest beds were accumulated, and in the successive overlap of the succeeding ones, we learn that the metamorphic rocks formed high land in the Cambrian sea, and that an interval of unrepresented time preceded the deposition of the Malvern Lingula flags. It thus appears that the metamorphic rocks of the Malvern district formed part of a slowly-subsiding area of emerged land during the period when the Lower Cambrian rocks of Charnwood Forest and the Longmynds were being deposited; and that as the subsidence went on, higher beds were brought consecutively into direct contact with the metamorphic rocks, until finally, at the close of the Lingula flag period, this area may have been nearly or entirely submerged and covered up. As these blanks in the sequence of sedimentary deposits were the results of the reverse of that change of level which gave rise to metamorphism and attended the accumulation of sediments, viz., local elevation of the crust of the earth, and emergence of the area from which the next overlying formation is absent, and as gaps or blanks belong to all ages, it follows that there must always have been areas of dry land ; and as the mean sea level, and therefore the relative proportions of dry land and water, probably never varied very greatly, there must have been emerged land in Lower Cambrian times over a united area of at least a fifth of the earth's surface, on which no deposition was taking place, causing breaks in the sequence of formations to which pre-Cambrian rocks formed the floors, and from which were derived the sediments that accumulated in the Cambrian sea.

But at some time after the close of the Lingula flag period, and between it and the epoch of the May-hill sandstone, the Malvern area was again elevated, as may be inferred from the total absence of the Llandeilo, Caradoc, and Lower Llandovery rocks, and from the tilted position of the Lingula beds, on the denuded surfaces of which the May-hill sandstone rests, dipping to the westward at a lower angle than the beds which underlie it. Again, at the close of the Lower Old Red Sandstone period, the ridge was upraised, as seen in the absence of the Middle Old Red Sandstone (Glyptolepis beds of Scotland) from the adjacent district, and in the attenuation of the Upper Old Red (Devonian beds), the Carboniferous Limestone, and Millstone Grit in the direction of the Malverns. And lastly, in the unconformable position of the Coal-measures, both on the north and south of the range, and of the Permian breccia to both the Coal-measures and overlying Trias, we have further evidence of repeated oscillations of level.

Similar changes of level affected the Cambrian area of Charnwood Forest. The Upper Cambrian and the whole of the Silurian and Old Red Sandstone systems are entirely absent. It was dry land in early Carboniferous times, as pointed out by Professor Jukes. It was subsiding, however, throughout the latter part of that epoch, and continued to do so until the close of the era of the Lower Coal-measures. The Upper Coal-measures are not known to occur in the neighbourhood with certainty, at least the evidence of their presence is not conclusive, and the Permian system not nearer than Ashby-de-la-Zouch, where some ' meagre traces' are supposed to exist by Mr. Hull,* forming marginal outliers of the formation. Be this as it may, the area was certainly upraised, and was probably dry land in the early Triassic sea, as shown by the shallow-water conditions which prevailed at the commencement of that period, and by the gradual subsidence of the area which followed, during which the Keuper marls closed over it.

The author denied that profound metamorphism of rocks over large extents of surface was ever solely due to erupted masses, the effect of which upon contiguous rocks was extremely limited, but considered it always the result of broad depression of the area to within the influence of the earth's internal heat. The intrusion of associated igneous rocks be regarded as sometimes contemporaneous with the metamorphic action, having taken place into fissures and chasms in the crust while depressed and still in a heated state, as shown by the coarsely crystalline structure of many of these rocks at their line of contact with those among which they have been injected, and in small granitic and other veins. In other cases, however, their posteriority in age was clearly shown by the opposite of these conditions.

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* Geology of Leicestershire Coal-field, p. 57.

IV.—On a Head of Hybodus Delabechei. By E. C. H. Day, F.G.S.

A HEAD of *Hybodus Delabechei*, Charlesworth, in the possession of the author, has upon it *in sitû* four of the cephalic spines first described, from a single specimen (and with the type of this species of Hybodus), by Charlesworth in 1839. Similar spines were subsequently described by Agassiz as *teeth*, and upon these supposed teeth that author founded a new genus of Hybodonts, which he named '*Sphenonchus*.' From the present specimen it is however clear, that these so-called teeth, or spines, are simply *dermal scutes*, such as are common in the Ray family, but not, as far as the author is aware, found upon any recent Shark. These scutes are placed, two on each side of the head, the anterior upon the post-orbital processes, the posterior upon the post-auditory processes, or hinder angles of the skull. The suggestion hazarded by Charlesworth, and provisionally supported by the author in a former paper, that these developments were analogous to the curious apparatus upon the head of the males of Chimærоid fishes, therefore falls entirely to the ground, and we have indicated to us instead a slight but interesting character of resemblance to a distinct family of Plagiostomous fishes, the *Raiidæ*. But the composite character of this extinct family is shown in other points, as the author infers from the char structure and position of the dorsal spines, &c., that the Hybodonts were allied to the *Chimæroids* as well as to the *Cestracionts* and the *Squaloids*, and that therefore the fossil group, of which *Hybodus* and *Acrodus* may be taken as types, was intermediate in its zoological position, between the two existing orders of *Plagiostomi* and *Holocephali*. In conclusion, the author drew attention to the coincidence between the past occurrence of *Hybodus* in the Jurassic age, and the occurrence at present of its nearest allies, the genera *Cestracion* and *Callorhynchus*, in, and almost restricted to, those Australasian seas in which are preserved to us so many traces of Mesozoic life.

V.—Remarks on the Drift in a part of Warwickshire, and on the Evidence of Glacial Action which it affords. By the Rev. P. B. Brodie, M.A., F.G.S.

THE extent and character of the low level drift round Warwick and Leamington and along the valley of the Avon was first described, containing in places the usual Mammalian remains, but no flint implements had yet been detected. Of older date, belonging to the Glacial period, was an extensive deposit of drift occupying the high table land over an area of from six to twelve miles, NNW. and W. of Warwick. Rounded pebbles and boulders of vario[illegible] and diverse mineral composition are scattered in greater or less abundance over the whole of this tract, including granite (rarely) and old rocks. Here and there some large erratic blocks are met with, but generally the pebbles are of small size, consisting mostly of sandstone and quartz. Large and small flints but little abraded are nowhere absent from this drift, though more abundant at some spots than others. Fossiliferous rocks are very rare, but at one place pieces of hard Chalk (rounded and scratched with flints,) Greensand, Oolites, Lias, Magnesian and Mountain Limestones, and rounded boulders of older formations, were indiscriminately mingled together. Hence it was inferred that an iceberg had deposited a portion of its load there. The other erratics consist of the usual detritus supposed to have been derived by the same means, generally from the North, though much of it may have been transported from other directions. The most novel and interesting fact was the discovery of *Orthis rudex*, *Lingula Lesueuri*, and a species of *Modiolopsis*, in the quartzose pebbles and sandstones figured and described by Mr. Salter in the 20th vol. of the Geological Journal, and first found in the New Red Sandstone at Budleigh, Salterton, in Devonshire by Mr. Vicary. It was inferred that these numerous pebbles of a similar lithological character had the same origin as the Devonian ones, and that in all probability the Upper Red sands and marls capped the Keuper in Warwickshire ; and, the softer beds having been denuded, the heavier materials were scattered about as they are now found. The few fossils hitherto detected in them by the author are, at all events, Lower Silurian species belonging to the 'armorican' sandstone and the quartzites of May Hill, Normandy. A list of some of the chief constituents of the drift was appended. Its prevailing contents are of a very mixed character, though the sandstone and quartzose pebbles largely predominate.

VI.—ON TWO NEW SPECIES OF CORALS IN THE LIAS OF WARWICKSHIRE. By the Rev. P. B. BRODIE, M.A., F.G.S.

AN unusually large species of *Montlivaltia*, as yet undescribed, was referred to, from the Middle Lias at Shipston-on-Stour, where it is abundant, the largest specimens measuring five to six inches in length, and three in diameter across the calicular surface, varying in form and size, some being more elongated and others more cyathiform. Most of the specimens are unfortunately much weathered, the epitheca being rarely preserved, but better ones could be obtained by quarrying ; one example of the so-called *Montlivaltia Haimei* was described, from the Lower Lias near Rugby. Though abundant in Nottinghamshire it is rare in Warwickshire, and is known also in Ireland, where it was first observed by Mr. Tate. It may perhaps be questioned whether this coral is correctly assigned to the Belgian species. Of late years the number of British Liassic Corals has greatly increased, and when all are published and described, the list will certainly equal, if it does not exceed, that already known in the foreign Lias.

VII.—ON A SECTION OF LOWER LIAS AT HARBURY, NEAR LEAMINGTON. By the Rev. P. B. BRODIE, M.A., F.G.S.

NO published account of this fine section having appeared, the author gave a detailed description of it, and a list of the fossils, pointing out its relation to the same part of the Lias series in Gloucestershire, Somersetshire, and Dorsetshire. This section was interesting as showing the Lima beds resting upon the White Lias, the intermediate Insect and Saurian beds being either entirely wanting, or else so reduced in bulk that they are most feebly represented, the whole passing downwards with the Rhætic series, also of limited thickness, including a sandy band with *Estheria minuta.*

VIII.—ON THE FOSSILIFEROUS BEDS IN THE NEW RED SANDSTONE (Upper and Lower Keuper) IN WARWICKSHIRE. By the Rev. P. B. BRODIE, M.A., F.G.S.

THE prevailing fossils in these two divisions of the Trias were described, especially the remains of Cestraciont fishes more perfect than usual in the Upper Keuper ; a species of *Palæoniscus* (the last of its race) *P. superstes*, and a new mailed fish undescribed, with plants profusely distributed in certain places, indicating a somewhat varied flora, and especially well-defined footsteps of *Rhynchosaurus* (noticed for the first time in the Upper Keuper), and *Labyrinthodon*, chiefly confined in Warwickshire to the upper division. The Lower Keuper is remarkable for its more or less perfect remains of Labyrinthodonts, of which a fine collection, the best in England, is contained in the Warwick Museum. Hence it was shown that predaceous fishes and salamander-like reptiles were comparatively abundant during this period, and if this formation was as largely quarried as many others, a more extensive fauna and flora would probably be detected. A larger extension of the Keuper was pointed out in a portion of the area occupied by it, while it reached its minimum thickness in Warwickshire as shown by Mr. Hull. The best sections of the Upper and Lower Keupers were described in detail, and the denudations which the district under review had undergone were accurately determined.

IX.—ON A DRIFT DEPOSIT NEAR LILLESHALL, SHROPSHIRE, CONTAINING RECENT MARINE SHELLS. By C. J. WOODWARD, of the Midland Institute, Birmingham.

THIS deposit was pointed out to the author by Mr. Masefield, of the Woodhouse Farm. It consists of a mound some thirty or forty feet high, the mound forming a field known as Fox Hill Field. It is situated about three miles from Oakengate Station on the Birmingham and Shrewsbury Railway, and is on the grounds of Mr. Duddlestone, New Lodge Farm.

The shells occur only on the north side of the mound, and are associated with fine gravel intermixed with thin bands of red clay.

Associated with the shells are pebbles of various kinds. They are principally of quartz, but many are of sandstone, curiously pitted on their surface. There are also small granite pebbles, rounded fragments of trap rock, Lias fossils much water-worn, and Chalk flints. The inclination of the strata of gravel in which the shells occur bears no relation to the slope of the hill; the gravels inclining at an angle of 70° or 80° to the north, while the mound on that side does not incline more than 30° or 40° in the same direction.

The south side of the mound does not appear to contain any shells; and, so far as it has been examined, the pebbles are of a different character from those on the north side.

From the mean of two barometrical observations the height of the mound is 463 feet above mean sea-level.

The shells found were determined by Mr. J. Gwyn Jeffreys, and are as follows :—

UNIVALVES.

Aporrhais pes-pelicani.
Buccinum undatum.
Dentalium abyssarum.
Fusus antiquus.
Nassa reticulata.
Natica clausa.
Purpura lapillus.
Scalaria communis.
Trophon Banffensis.
Turritella communis.

BIVALVES.

Astarte borealis.
Cardium echinatum.
Cardium edule.
Cyprina Islandica.
Lutraria elliptica.
Mactra solida.
Pecten opercularis.
Pholas crispatus.
Tellina (*solidula*) *Balthica.*

CIRRIPEDES—*Balanus sulcatus.*—*Balanus Scoticus.*

X.—GENERAL VIEW OF THE PALÆOZOIC FLORAS OF NORTH-EASTERN AMERICA.

By J. W. DAWSON, LL.D., F.R.S., F.G.S.

THE Carboniferous is the newest Palæozoic Flora known in North-eastern America. The CARBONIFEROUS system comprises—

1. The '*Upper Coal Formation*,' which consists of sandstones and shales without productive beds of coal; its flora may be characterized as being a selection of some of the most widely diffused and probably most persistent species in the preceding 'Middle Coal Formation.'

2. The 'Middle' or 'Productive Coal Formation' includes all the productive coal, and is the head-quarters of the Coal Flora. Dr. Dawson has catalogued in it 150 true species, 92 of which are common to Nova Scotia and Europe, and 59 to Nova Scotia and the United States; the greater part of the remainder are closely related to the European Coal species, so that the vegetation and the physical conditions attending the deposition of the European and American Coal-strata may be regarded as identical.

3. *Sandstones and Shales*, equivalent to the Millstone-grit of England, containing no productive coals and few plants.

4. The *Lower Carboniferous Marine Formation*, equivalent to the English Mountain Limestone; it has afforded no well-characterized land plants, and

5. The '*Lower Coal-measures*,' *or*, '*Sub-Carboniferous*,' with no productive coal; its plants are very abundant but restricted to a few species, and these markedly distinct from those of the true Coal-formation.

The next system, in descending order, is the DEVONIAN, which in North-eastern America is unconformable to the Carboniferous, and contains a totally different series of plants. Dr. Dawson has observed and catalogued about 82 species from these rocks in New Brunswick, and only ten of them can be identified, but doubtfully, with Carboniferous forms; perhaps the Lower Coal Formation may be regarded as in some degree a transition group distinguishable from the Devonian Flora below and the Carboniferous above. The whole Devonian Flora appears to be one; for though only two of the Upper Devonian species can with certainty be referred to the Lower Devonian, yet these are two of its characteristic species.

The *Lower Helderberg Formation* is the only part of the UPPER SILURIAN GROUP that has hitherto afforded land-plants, and at only one locality, Gaspé, and here there appears to be a gradual passage from the Upper Silurian Limestones into the Lower Devonian Sandstones; these plant-remains are the markings of the rhizomes of *Psilophyton*, and leaf-like impressions doubtfully referred to the Lower Devonian *Cordaites angustifolia.*

Dr. Dawson notices the fact that the earliest known traces of land-plants occur in rocks of a similar horizon, both in Britain and America; he regards many of the so-called fucoids of the Lower Silurian Rocks of Canada as merely worm-burrows, trails of crustaceans or molluscs, shrinkage cracks, or concretions, some few, however, are undoubtedly algæ; he has been unable to discover in any of the Lower Silurian forms the structure of land-plants, not even in the Potsdam Sandstone, which containing littoral deposits would thus seem to indicate a paucity in the land-vegetation of the period. He also states that though he has not at present succeeded in recognising any determinate forms in the graphitic matter of the Laurentian rocks, which presents the appearance of comminuted remains of algæ, yet he entertains the hope of doing so.

CORRESPONDENCE.

ON THE NORTH STAFFORDSHIRE COAL-FIELD.

To the Editors of the GEOLOGICAL MAGAZINE.

SIR,—In the paper which Mr. Molyneux read before the Geological Section of the last meeting of the British Association in Birmingham, he referred to a bed of greyish shales, lying a few feet above the Gin Mine Coal and belonging to the upper part of the low or thick measures of the North Staffordshire Coal-field. These shales, he justly remarks, surpass the Bog Mine in the number and variety of their organic contents. As you were informed by himself, Mr. Ward, of Longton, had previously found beds of true marine shells in these measures. But the shales referred by Mr. Molyneux, as being sunk through, last June and July, were first noticed by a young man in this town of the name of Amison, who obtained from them, not only the fossils named in the above paper, but several others. Among the rest was a very large *Nautilus*;

the broadest part of the outer whorl would be some three inches across. In the upper part of the fossil bed he found two species of *Lingula*. Lower down, two species, at least, of *Chonetes*; some four species of *Goniatites*; one species of *Inoceramus*? one *Pecten*; *Posidonia*, one species; *Productus*, one species; *Spirifer Urii*; *Nucula* or *Ctenodonta*, two if not three species; *Aviculopecten*, at least two species; *Axinus carbonarius*; *Strophomena*? *Pleurotomaria*, *Orthoceras*, and *Anthracosia*. In the same shales I found a solitary fish-tooth. Mr. Ward thinks it is a *Cladodus* tooth—but if so, the base of it is flatter and much broader than any teeth of this fish that I have seen.

But what increases the interest and importance of these beds of marine shells, is the fact that a considerable number of the species obtained from them are identical with those I obtained a few years ago, from a bed of shale in the Farewell Rock series of the South Wales Coal-basin. The bed in question crops out in the Llanelly valley, a mile or so beneath the town of Brynmawr, and appears to occupy a position midway between the lowest seam of coal, and the Carboniferous Limestone. Thus the fossils which in Wales are found considerably below the lowest bed of coal, are, in North Staffordshire, found high up in the lower thick measures. I am informed by gentlemen practically acquainted with the district, that the lowest seam of coal in this field is at least eight hundred yards below the bed containing the above fossils. The natural inference is—that either the species of shells which I have obtained from the two localities of Staffordshire and Wales, had an immense range in time—or else that the Coal-measures of North Staffordshire extend much lower in the series of Carboniferous rocks than do those of Wales. In either case the facts are both instructive and interesting.

In closing this brief notice, I may just remark, that about forty yards *beneath* the beds referred to by Mr. Molyneux, Mr. Amison was fortunate enough to detect another bed containing marine shells, but in less numbers than the upper bed, both with regard to species and individuals. What is most important, is that all the species which we obtained from the lower bed are different from those obtained from the upper one, and appear to have been a great deal worn before deposited. Among those we found was a very small *Nautilus*, two species of *Nucula*? one *Naticosa*, and one that looks like a very broad and short *Anthracosia*, and a small *Goniatites*.

Yours truly, S. LUCAS.

LONGTON: *Oct.* 4, 1865.

ANECDOTE OF STEPHENSON.

To the Editor of the GEOLOGICAL MAGAZINE.

SIR,—As I communicated the anecdote of the late Mr. George Stephenson sometime before I observed or paid any attention to the rocks of Charnwood Forest, would you allow me to make a correction by stating that, though it was formerly customary among miners to apply the term granite to all the igneous rocks of Leicestershire, the rock through which Mr. Stephenson penetrated was really *greenstone*, as noticed at page 499 of your last number. Mr. Hull, in the 'Memoirs of the Geological Survey,' gives a correct account of this achievement. My anecdote is original only as regards the words used by Mr. Stephenson on the occasion. Yours truly,

D. M.

SIR,—The anecdote in the concluding paragraph of your November number is interesting, in spite of its geological inaccuracies, as it tends to throw light on a question that has often puzzled me. The facts are these :—A very slight examination would show that the Coal-measures of the Coleaton and Snibston Field pass to the east beneath a thick mass of New Red marl and sandstone, and that still further to the east the two must abut and end off against the western flank of the mass of slaty and igneous rocks of Charnwood Forest. Thus much we may safely assume that Stephenson knew when he began to sink through the New Red at Snibston in search of the Coal-measures. The sinking was carried down through the marls and the underlying sandstone till a bed of greenstone (not 'granite') was struck. It would have been only natural to take this for the underground prolongation of the Charnwood Forest rocks, and consequently to conclude that the shaft was too far to the east, and that there was no hope of finding Coal-measures there. But, nothing daunted, Stephenson carried on his work, and after passing through sixty feet of greenstone reached, not 'more productive Coal-measures,' but the first Coal-measures that had been met with in the shaft. Now I have often wondered whether Stephenson had any *reason* for hoping in the end to be successful, or whether it was only a plucky determination to go on, even in the dark, and see what would come of it. I think your anecdote shows that the latter was the case; but perhaps some of your correspondents may be able to tell us more on the subject. Yours obediently,

A. H. GREEN.

28, JERMYN STREET: *Nov.* 7, 1865.

ANCIENT BRONZE IMPLEMENTS.

To the Editor of the GEOLOGICAL MAGAZINE.

DEAR SIR,—I hear that bronze implements have been discovered in the Kirkhead Cavern. Surely the exact analysis of the metal of which they consist would prove of interest. If samples of ancient bronze, brass, or other alloys are placed at my disposal, I shall be most glad of the opportunity of analysing such of them as are likely to yield good results. Fragments of from five to ten grains generally afford sufficient material for one quantitative analysis, but a larger quantity is preferable.—I am, dear Sir, yours truly,

A. H. CHURCH.

R. A. COLLEGE, CIRENCESTER: *Oct.* 29, 1865.

ON THE DISCOVERY OF OPHIURA WETHERELLI AT HERNE BAY.

To the Editor of the GEOLOGICAL MAGAZINE.

DEAR SIR,—During a recent visit to Herne Bay I was fortunate enough to obtain some specimens of a pretty little Star-fish—*Ophiura Wetherelli*, of Forbes, from what I suppose to be the basement-bed of the London clay; and as this species appears to have been only hitherto obtained from the upper beds of the London clay at Hampstead and Highgate, or in still higher beds at Barton, as mentioned by Professor Forbes (Pal. Soc. Mon., page 33), a notice of its occurrence at a lower level in the Tertiary series may possibly be interesting to some of your readers.

My specimens of *Ophiura* were imbedded in a block of hard ferruginous sandstone in association with numerous specimens of *Cardium Laytoni*, which formed a layer several inches in thickness, and with which indeed they were so closely intermingled as to render their extraction, in anything but a fragmentary condition, a matter of extreme difficulty.

The block of sandstone appeared to have fallen from a bed of sand, which would answer to group 2 in Mr. Prestwich's 'Section near Herne Bay' (Quar. Jour. Geol. Soc., vol. vi. p. 265), and the place on the shore must be about a mile and half east of Herne Bay, and about midway between the rise of the sand-beds from beneath the London clay and a break or ravine in the cliffs a little further to the eastward.—Yours truly,

C. J. A. MEYER.

CLAPHAM COMMON: *Oct.* 17, 1865.

MISCELLANEOUS.

NOTES ON THE FOSSIL MAMMALS OF AUSTRALIA.

By GERARD KREFT, Esq., Curator of the Australian Museum, Sydney.

(Extracted from the 'Australasian,' August 4, 1865.)

I believe that the late Sir Thomas Mitchell was the first discoverer of fossil remains of mammals in Australia, and they were obtained in the caves of Wellington Valley, New South Wales. Some of these fossils were deposited in the Australian Museum, at Sydney, and others handed over by Sir Thomas to the Geological Society of London.

Professor Owen, who examined them at the explorer's request, states that they belong to the following genera:—

1. *Macropus atlas. O.* Larger than the largest known existing species. 2. *Macropus titan. O.* As large as the preceding, but differing chiefly in the smaller size of the permanent spurious molar. 3. *Macropus, spec.* Not determined by the learned professor, from want of skeletons of existing species of kangaroo. 4. *Macropus, spec.* Another undetermined kangaroo. 5. *Hypsiprymnus, spec.* Not determined. 6. *Hypsiprymnus, spec.* Not determined. 7 and 8. *Phalangista.* Two as yet undetermined species. Professor Owen

remarks :—'A comparison of the fossils with the bones of existing species (which are much wanted in our osteological collections) is obviously necessary to establish the important fact of the specific difference, or otherwise, of the extinct Phalanger.' 9. *Phascolomys Mitchellii. O.* This 'wombat,' according to Owen, comes nearer to the existing species than any of the preceding genera. 10. *Diprotodon* Subsequently described as *Diprotodon Australis. O.* The largest of the extinct marsupials—an animal which in bulk must have exceeded a large elephant. I give the measurements of some of the bones in the Australian Museum :—Skull, 3ft. ; Scapula, 2ft. 4 in. ; Humerus, 2ft. 2in. ; Femur, 2ft. 5in.' Toe-nail, 8in. 11. *Dasyurus laniarius. O.* Larger than any of the existing species.

These are all the animals enumerated by Professor Owen in 1838. Since then many new discoveries have been made, in other parts of the country, but more particularly by Mr. Isaacs on the Darling Downs, and Mr. Stutchbury at Wellington, and other localities.

I believe that some of the breccia from the Wellington caves, lately examined by me, and in which I discovered the fossil remains of rodents and dogs, was collected by the late Mr. Stutchbury ; and though this eminent Geologist does not in any of his papers refer to these fossil remains, I have no doubt, judging from a few specimens displayed in the Museum collection, that he was cognizant of the existence of both dogs and rats in a fossil state in Australia.

Many of the lumps of this breccia had never been examined before ; and besides teeth of dogs and rodents, they contained the remains of animals, in a fossil state, which at the present day exist only in Tasmania.

I will now give a list of the specimens so discovered :—

1. The second molar tooth of the right ramus, upper jaw, of a species of *Thylacine.*
2. The third molar tooth of the left ramus, upper jaw, of a *Thylacine.*
3. Four fragments of canine teeth, probably belonging to the same genus.
4. Twelve molar and premolar teeth of a species of *Sarcophilus* (now confined to Tasmania), and a canine tooth of the same.
5. Portion of the left ramus, upper jaw, of a species of *Sarcophilus,* showing the second premolar, and suture of the first molar.
6. Portion of the left ramus, upper jaw, of a species of *Sarcophilus* much larger than the preceding one, with the first and second premolar and first molar tooth *in situ.*
7. A skull, nearly complete, of the same species, showing the perfect dentition (somewhat crushed).
8. Portion of left ramus, lower jaw, with canine first, second and third premolar, and first of the molar series.
9. Right ramus, lower jaw, of a Dasyure allied to *Dasyurus maculatus,* with three premolar and two first molar teeth.
10. Portions of the right ramus, lower jaw, of a species of a *Perameles,* containing the first two premolar and first two molar teeth.

11. The same bone of a species of *Perameles*, without teeth, but showing nearly all the sutures.

A conglomerate mass of bones and red gravel, after being broken with a hammer, was found to contain the first two molars of the lower jaw of a dog; it is possible that this dog was similar to the Dingo of the present day. The left canine of the lower jaw of a dog was also obtained, besides six or seven fractured lower jaws of rodents, and portions of molar teeth of *Diprotodon*; but the most curious and interesting tooth I ever beheld came out of the same mass. In shape it resembles the first of the premolar series of the lower jaw in man; the root, however, is much longer, the crown smaller, protruding, and considerably worn. The root is not smooth, as in man, but somewhat ridged, with a few tubercles on the upper part. I have no conjecture to offer as to which genus this tooth is referable; but as I have given Professor Owen a full description of it, with drawings and photographs, I hope to be able to lay the reply of the great anatomist before your readers at some future period. These are all the mammals (besides *Hypsiprymni* and *Halmaturi*) obtained from the Wellington caves; there are bones of birds as well, but the pieces are too fragmentary to permit me to offer an opinion upon them at present. I should also wish to give a short account of the fossil remains from the Darling Downs, which are deposited in this museum, but will do so at another time; and only state now that in the famous genus *Thylacoleo*, as predicted by Professor Owen, the lower canine terminated the dental series, showing a great resemblance between the great Australian carnivore (?) and the diminutive marsupial discovered by Mr. Beccles, in the Purbeck formation of England.

I mention this fact because it appears to me that many of your readers may not be aware that at some remote period marsupial forms inhabited Europe, placentals were in existence, and that there is no occasion to account for the presence of placentals in Australia in any other way than that they already existed in the times of the gigantic *Diprotodons* and *Nototheriums*.

COAL IN BRAZIL AND THE FALKLAND ISLANDS.—Professor Agassiz, with his staff, has been engaged in a careful survey of the district watered by the Amazon, and his opinion has also been obtained concerning the Coal-fields of Candiota. For some time past attention has been directed to the famous Coal-beds of Candiota, in the province of Rio Grande do Sol. The expectations of many are turned in that direction, as the most valued instance of the hidden wealth of Brazil. Mr. Plant has so far awakened or revived an interest in these things, that from time to time the topic has become a public one, and has been looked at as a field for commercial activity, and has been debated each time with growing interest in the Legislature. Mr. Plant, submitted to the examination of the Professor such fossils and geological illustrations of the province of Rio Grande do Sul as he supposed would be of interest, and would help to complete the collections which are being made for the United

States Government. These fossils appear to have startled and delighted him, and in acknowledging the presentation of the specimens he remarks, after alluding to his slight delay in returning his thanks—'However, this gives me an opportunity of expressing a more mature opinion concerning their geological age, which I am glad to have an opportunity of recording, especially since the examination I have made of them has satisfied me of the correctness of some views concerning the fossils of the oldest geological formation, in which I had little confidence. That these organic remains all belong to the Carboniferous period is unquestionable, and it is the close affinity with the characteristic fossils of Europe which particularly interests and, in a measure, surprises me. Had the whole collection been made in Pennsylvania, I would not more decidedly have recognized its Carboniferous characteristics, down to the rocks underlying and overlying the fossiliferous beds; and the photographs you have shown me of the localities leave no doubt of the great extent and value of the Coal-beds proper of the River Candiota, whilst the coal itself may fairly be compared to the best in the market, judging from the specimens you have shown me, and those I owe to your kindness. As to the coal of the Falkland Islands, I can only compare it to the anthracite of Mansfield, in Massachusetts, and the adjoining deposits in Rhode Island; though it does not appear quite so pure as the best anthracite of the United States: but this is an impression derived from surface specimens gathered at random.'—*Anglo-Brazilian Times, Rio.*

'WULFENITE' (MOLYBDATE OF LEAD) IN BRITAIN.—We have just received and examined a mineral belonging to Mr. James Farie, Honorary Secretary of the Glasgow Geological Society; which, judging from its general characters, appears to be 'Wulfenite,' (Molybdate of Lead).

The mineral is well crystallized (in drusy cavities of quartz—associated with green Calamine) in rectangular tables with the edges bevelled, of a honey-yellow, or rather citron-yellow colour, and adamantine lustre. Its hardness is between 2 and 3. It decrepitates strongly on the application of heat, and gives a yellowish-green bead with microcosmic salt in the reducing flame, much resembling the Molybdic acid bead. But the quantity that could be removed for testing, without injury to the specimen, was so exceedingly minute that the reaction was hardly so satisfactory as might be desired.

If it be 'Wulfenite'—as to which there seems but little doubt—it will be of considerable interest to the Mineralogist, being, we believe, hitherto wholly unknown in Britain.—E.F.

[A specimen of Wulfenite is described in Greg and Lettsom's Mineralogy (1858, p. 411), on the authority of Mr. Thompson's work, as having been seen by the last-named writer in the Museum of the Stockholm Academy, labelled 'From the Mendips, near Churchhill, in Somersetshire;' the crystals of Wulfenite on this specimen were associated with oxychloride of lead. We shall be glad to learn from Mr. Farie the exact locality of his specimen.—EDIT.]

CLIONA, RECENT AND FOSSIL.—The *Cliona* is a burrowing sponge, found in sea-shells in all parts of the world, and in fossil shells of the Chalk and Tertiary formations. The species of *Cliona* may be distinguished by the form of the *spicula*, and in the earlier stages of growth, by the patterns of their burrows. The pattern is well seen in thin translucent shells, like the window-oyster (*Placuna*). Casts of the burrows of *Cliona* are common in cavities of flints (formed by the dissolution of the shells of *Belemnites* and *Inoceramus* from the chalk. The *Cliona* is very destructive to oyster banks, mining the shells until they fall in pieces.—S.P.W.

THE EGG OF DINORNIS.—Mr. J. C. Stevens (the well-known Natural History Agent) has lately received from New Zealand an almost perfect egg of the great extinct wingless bird, the 'Moa' or *Dinornis*. The egg is about ten inches in length, and seven inches in breadth, the shell being of a dirty brownish colour, and about 1-12th of an inch in thickness. According to the Wellington papers, the egg was discovered in digging the foundation of a house at Kai-Koras, enclosed in a small mound, supposed to be a native burying-place, as a human skeleton, buried in a sitting posture, was found within the grave holding the egg in its hands. It would have been more satisfactory, we think, if the skeleton—especially the skull—had been brought to this country with the egg. This interesting oological relic was offered for public sale on November 24th, by Mr. J. C. Stevens. A *bonâ fide* bid of £115 was actually made, but it was bought in at £125. We fear our countrymen in New Zealand have somewhat over-estimated its market value.

PRESENTATION OF THE ROYAL SOCIETY'S GOLD MEDAL.—At the Anniversary Meeting of the Royal Society on the 30th November, the President presented the gold medal of the Society to Joseph Prestwich, Esq., F.R.S., F.G.S. (Treasurer of the Geological Society of London), for his valuable researches in the Quaternary Deposits of France and England, the results of which have already appeared in the Philosophical Transactions, Part I. 1859, Part II. 1864.* It is in these ancient river-drifts and gravels that the earliest remains of Prehistoric Man have been found preserved. Mr. Prestwich's labours in the exploration of these deposits have thrown much additional light upon that most interesting question of our time—the Antiquity of the Human Race.

OBITUARY.

We regret to record the death of Mr. Lovell Reeve, on the 18th November, after thirteen months' severe illness. Mr. Reeve was a Fellow of the Linnæan Society, and was well known, not only as a publisher, but also as an author of numerous and valuable contributions to the Natural History of the Mollusca.

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* See GEOLOGICAL MAGAZINE, January 1865, p. 19.

INDEX.

ACANTHOTEUTHIS, 444
Actinocrinus, 245; *A. brevicalix*, 12
Adams, A. L., fossil elephant of Malta, 334; history of the discovery of the fossil elephant of Malta, 488
Adams, A. L., and G. Busk, on the Maltese Caverns, 520
Address of D. Page to Edinburgh Geological Society, 37, 420
— of Prof. Phillips to British Association, 456
— of Sir R. I. Murchison to Section C. of British Association, 462
Africa, changes in the geological map of South, 274
Agassiz, L., Scientific Exploring Expedition, 335
Airdrie, *Tellina proxima* bed at, 127
Aitken, J., on glacial action at Clitheröe, 179
Allis, T., on the *Dinornis robustus*, 88
Allport, S., on the distribution of the Upper Silurian fossils, 281
Alps, Structure and dendation of the, 49, 193
Alum Bay leaf-bed, 515
American Journal of Science, 206
Ammonites, development of, 86
Analysis of ferrite, 40
Ancient Straits and Creeks, 302; Sea-cliffs, 304; Sea-beaches, 374
Anecdote of G. Stephenson, 528, 570
Anopolenus, 318
Ansted's D. T., Applications of Geology to the Arts and Manufactures, 266
Anthracite in Mexico, 192
Anthrakerpeton crassosteum, 6
Anticlinal in the chalk near Norwich, 324
Antimonite, 238
Antimony-minerals from Borneo and Algiers, 238
'Antiquity of Man,' 348, 357, 459
Antwerp Crag, 103, 149
Arabia, Cretaceous Echinoderms, 177
Aragonite, growth of coralloidal, 272
Archæopteryx, cranium of the, 413
Arctic fossils, 336
Ardtun Head, Tertiary leaf-beds of, 74
Arenicolites didyma, 391
Armadillo, 400
Armstrong, J., on *Dithyrocaris*, 219
Arran, Drift-beds of, 126
Austin's, T., Millstone Grit, and its fossils, 552
Austria, Liassic crinoidal limestone of Lower, 17
Avicula-contorta beds, 228

BADEN, geological notes on, 373
Bagh, Cretaceous Echinoderms from, 177
Bavaria, Laurentian rocks of, 97
Baily, W. H., on *Palæchinus*, 44, 217; on the Cambrian rocks, 385
Bain, A. G., obituary notice of, 47
Bath Natural History and Antiquarian Field-club, 84
Beckett, H., On Cannel coal in North Wales, 33
Belemnites clavatus, 189
Belemnites, structure of, 67
Belfast Field-Naturalists' Club, 134
Belgian bone-caves, 138, 227
Beneden, P. J., on the Squalodons, 405
Berkshire, geology of, 64
Bevan, G. P., on the coal-basin of South Wales, 158
Binney, E. W., on the genus *Polyporites*, 404

Birkenhead, E. H., on the coal-basin of New South Wales, 235
Blackmore, H. P., on flint implements from Salisbury, 177
Bloody stone, 380, 441, 526
Bohemia, Laurentian rocks of, 97
Bone-caves of Belgium, 138; of Liége, 227
Bonney, T. G., on modern volcanoes in Central France, 241
Bouchard, N. R., obituary notice of, 96
Boulder-clay of Heaton Mersey, 236, 381; of East Yorkshire, 347
— Drift of Queen's County, 444
Brackish waters and their deposits, 16
Brady, H. B., on the lowest forms of animal life, 223
Bray Head, trap at, 217; sketch of, 389
Brick-earth of the Nar, 8; list of Post-tertiary fossils from, 11
Brimham rocks, 154
Bristol Coal-field, 133
— Naturalists' Society, 42, 132, 222, 321
British Association, 83, 456, 513, 558
Brixham Cave, 349
Brocklehurst, C., on the geology of Cloud Hill, 375
Brodie, P. B., on Lias outliers, 71, 227
Brosely 'burning well,' 232
Brown, D. J., on fossils in the Silurian shales of Dumfriesshire, 382
— on the geology of Moffat, 320
Browne, G. F., on Ice-caves, 85
— Ice-caves of France and Switzerland, 449
Bryce, J., on crag in West Scotland, 127; on the drift-beds of Arran, 126
— on the *Tellina proxima* bed at Airdrie, 127
Bryson, A., on surface-markings, 189
— on the upheaval of the shores of the Forth, 277, 328
Buckinghamshire, chalk of, 215; geology of, 64, 210
Burmeister, G., Annals of the Museum of Buenos Ayres, 451
Burrington Coomb Cavern, 81
Busk, G., and A. L. Adams, on the Maltese Caverns, 520
— and the late H. Falconer, on the Genista Cave, 177
Bust of W. Haidinger, 95

CALIFORNIA, Trias of, 307
Cambrian rocks and fossils, 385
Cambro-Silurian strata, and fossils, 222
Campbell, J., on different results of ice-action in Scotland and Switzerland, 187
— J. F., Frost and Fire, 416; Short American Tramp, 415
Calaite, 237
Calamite-fruits, 544
Californian Geology and Gold, 207
Canadian Naturalist and Geologist, 209
Cannel Coal in North Wales, 33
Canterbury, New Zealand, physical geography of, 269
Capewell, L. P., on the Metal Tungsten, 509
Carboniferous Limestone outlier near Corwen, 283
— Limestones of Carluke, 275
— Rocks of Clifton, 83
— Sandstone with surface marks, 136
Carruthers, W., on a fossil cone, 433; on a tree-fern from the Upper Greensand, 484
— and Young, on the Silurian Shales of Moffat, 431
Carpenter, P. P., on the connection between the crag and recent faunas, 152
— W. L. on the *Eozoön Canadense*, 222
Catkin Hills, Trap rocks of the, 131
Caulopteris punctata, 484
Caverns of Malta, 520
Caves of Gibraltar, 213
Cephalaspis, 517
Cephalopoda, Cretaceous, of India, 271
Cervantite, 238
Cervus elaphus, jaw bone of, from Spithead, 46
— *megaceros*, indentations in bones of of, 28, 216
Chalk, dip of the, in Norfolk, 370
— formation of flints in, 132
— of Thanet, 214; of Buckinghamshire 215; of the Isle of Wight, 215
Characteristic fossils, 37
Charnwood Forest, geology of, 498; Laurentian rocks of, 233
Chesil Bank, 72
Christy, H., obituary notice of, 286
Church, A. H., on New Minerals, 236; on the colouring matter of Blue Forest Marble, 48
Cirripedia, new genus of, 319
Clarke, W. B., on a new gold-field in New South Wales, 330
Classification of the Cretaceous rocks, 197
Clifton, Carboniferous rocks of, 83
Climate of the Trinidad Tertiaries, 259
Cloud Hill, geology of, 375
Clwyd Vale, geology of, 380, 476, 523

COA

Coal basin of New South Wales, 235; of South Wales, 158
Coalbrookdale, geology of 514
Coal-field at Thirsk, 140
Coal-fields of Bristol, 133; of Ireland, 34; of South Staffordshire, 280, 501, 508
Coal-measures, former extension of the, 135
— of Boulsworth, 180; of New South Wales, 70
— Question, 550
Coal-shale of Glamorganshire, New Reptile from the, 6
— Tar, products of its distillation, 184
Cocchi, I., on the *Pharyngodopilidæ*, 411
Codonaster, 250
Codrington's, T., Geology of the Berks and Hants Railways, 505
Collyhurst, Hazel nuts in an alluvial deposit at, 79
Congress of French Delegates, 192
Connemara Marble, *Eozoön Canadense* in, 87
— Rocks, 471
Coprolites, Entomostraca in, 140
Cork Cuvierian Society, 281
Correspondence, 45, 87, 135, 189, 231, 283, 326, 377, 428, 471, 520, 569
Cossham, H., on the Bristol Coal-field, 133; on the Geology of Kingswood Hill, 110
Cotteswold Naturalists' Field Club, 228, 371
Crag in West Scotland, 127
— relation of the, to recent faunas, 152
Crags of Suffolk and Antwerp, 103, 149
Cretaceous beds at Ely, 530
— Cephalopoda of S. India, 272
— rocks, classification of the, 197
— rocks of France and England, 113
Crinoidal limestone of Lower Austria, 17
Crosskey, H. W., on the Ice-age in Scotland, 183
Crustacea, chart of, 468; teeth of, 401
Cumberland, Lower Silurian rocks of, 176
Cumengite, 238
Cuvierian Society of Cork, 281
Cyathocrinus, 246
Cycads and palms of the Carboniferous period, 288
Cypræa, new species of, 536

DAGLISH, J., and G. B. Forster on the Magnesian limestone of Durham, 29, 355

DUB

Darbishire, R. D., on the Macclesfield drift fossils, 41, 293
Darwinism, 308
Davidson, T., award of Wollaston medal to, 139
Davies, D. C., on an outlier of Carboniferous limestone near Oswestry, 283; on the 'Ash-bed' and 'Bala' Limestones near Oswestry, 343; on the Vale of Clwyd, 476; guide to Llangollen, 271
— W., jaw-bone of *Cervus elaphus* from Spithead, 46; on the preservation of fossil mammals, 239
Dawkins, W. B., on Mammalian remains from Yorkshire, 364; on the dentition of *Rhinoceros megarhinus*, 412; on the formation of the Burrington Coomb Cavern, 81; on the Newer Pliocene Mammalia of Somersetshire, 43; on the Rhætic fossils, 482
Dawson, J. W., On the Structure of *Eozoön Canadense*, 35
— T. on the Belgian bone-caves, 138
Day, E. C. H., on *Belemnites clavatus*, 189; on *Xiphoteuthis elongata*, 189; on the Lower Lias of Lyme Regis, 518
Dead sea, geology of, 254
Denudation, 476; atmospheric and oceanic, 519; of the Alps, 193; of the Weald, 363
Dentition of *Macrauchenia patachonica*, 520; of *Rhinoceros megarhinus*, 412
Delvauxite, 237
Desor, E., Lake-habitations of the Lake of Neufchâtel, 26
Destruction of marine animals, 141
Devonian rocks of Ireland, N. Devon, and Rhenish Prussia, 275
Devonshire, changes in the relative level of the land and sea in, 348
— Glaciation in, 473, 526
Diluvial formations, table of, 360
Dinornis robustus, 38
Dinotherium, Pelvis of, 18
Disappearance of an Island, 139
Dithyrocaris, 219
Donegal, crumpled granite in, 216
Dougall, physical geography of Glasgow, 77
Doyne, W. T., on the rivers and plains of Canterbury, 269
Drew, F., on Romney Marsh, 210
Drift-beds of Arran, 126; of Ireland, 92; of Macclesfield, 366; of Haslingham, Norfolk, 511
Drift of Whitlingham, 370
— Divisions of the, 70
Dublin Quarterly Journal of Science, 34, 151

Dudley and Midland Geological and Scientific Society, 33, 79, 280, 321, 508
Dudley Silurian rocks and fossils, 509
Duff, J., on Carboniferous sandstone with surface-marks, 136
Dufresnite, 237
Dumfriesshire and Galloway Natural History, &c., Society, 226, 373
— Fossils in the Silurian shales of, 382
Duncan, P. M., on Arabian and Indian Echinodermata, 177
Durham, Magnesian limestone of, 29, 355

EARTHQUAKE at Morecambe Bay, 191
Earth's Crust, movements in the, 131
Ebbw Valley, view of, 160
Echinodermata from Arabia, and the Nerbudda, 177; from the Mountain-limestone, 245
Edinburgh, Geological Society of, 37, 76, 129, 181, 218, 275, 320, 420.
Edwards, F. E., on new Eocene species of *Cypræa* and *Marginella*, 536
Eigg Isle, geology of, 75
Elephant of Malta, fossil, 334
Elephas Melitensis, 490
English Channel, date of, 362
Entomostraca in Coprolites, 140
Eozoön Canadense, 3, 34, 35, 223, 462, 87
Equisetum in Gneiss, 239
Erratic block, recent, 37
Errors of Geology, 116
Etheridge, R., on the *Avicula-contorta* beds at Garden Cliff, 228
— and T. H. Huxley's Catalogue of Fossils in the Museum of Practical Geology, 268
Eurypterida, new genus, species of, 318
Evans, J., on the *Archæopteryx*, 413
Excavation of River-valleys, 463

FALCONER, H., memorial of, 191, obituary notice of, 142
— on the fluviatile deposits of the Nile and Ganges, 213
Faults of the South Staffordshire Coal-field, 508
Fee's, A. L. A., Le Darwinisme, 308
Feldspars, 445
Felis antiqua, Teeth of, 43
Ferrite, analysis of, 40
Field-clubs and local geological societies, 337
Finland, rocks and minerals of, 534
Firth of Forth, upheaval of the shores of the, 76, 181, 277
Fisher, O., extraction of elephant tusks from the matrix, 45; on a sinking of the soil at Lexden in Essex, 101
Flemingites, 438
Flint-implement-bearing Beds, Geological position of, 19
Flint Implements in the Drift, 177; not authentic, 455
Flints, formation of, 132
Flint weapons, discovery of, at Marionville, 76
Flos Ferri, growth of, 272
Flower remains from Alum Bay, 516
Folkestone, phosphate-bed at, 527
Foot, F. J., on a recent erratic block, 37; on glacial striæ in Longford, 524
Foote's, R. B., stone implements of Madras, 503
Foraminifera, 223
Forest Marble, colouring matter of, 48
Forster, G. B., and G. D. Daglish on the Magnesian limestone of Durham, 29
Fossil Cone; 433; elephant of Malta, 488; fish from Malta, 145; mammals from Uruguay, 528; plants of Hungary, 445; shells in the sea-bed near the Channel Isles, 517; spider, 468; trees in sandstone beds, 420; wood in flint, 292
Fossils, Catalogue of, 268; characteristic, 37; from the Arctic regions, 336; from the Genista Cave, 178; from the glacial beds of E. Yorkshire, 348; from the Macclesfield drift, 298, 365; from the Pentland Hills, 183; from the Trinidad Tertiaries, 257; of the Cambrian rocks, 385; of the Cambro-Silurian strata, 222; of the Dudley Silurian rocks, 510; of the Rhætic beds, 482; of the Silurian shales of Dumfriesshire, 382
Foster, C. Le N., and W. Topley on the Medway gravels, 363
Fox, W., discovery of new fossil reptile, 432
Franconia, geological notes on, 273
Freshwater shells in Permian rocks, 204
'Frost and Fire,' 415
Fulgurite from sand-pit at Macclesfield, 368

GANGES, Fluviatile deposits of the, 213
Ganoid fishes of the Midlothian Coal-field, 320

Gaudin, C. H., and M. Moggridge, on the geology of Mentone, 205
Geikie's, A., Geology of the British Isles, 125
Genista cave, fossils from, 178
Geological anecdote, 528, 570
— changes in Scotland, History of the last, 71
— excursions to Biddulph, 374; to Hunstanton, 511; to Llyndis, 427; to Rye Water, 368; to Shrewsbury, 373; to Stroud, 371; to the Strathblane district, 425.
— map of the Rhenish provinces and Westphalia, 469
— notes and queries, 89.
— Notes on Scotland, 253
— Progress, 290, 337
—Society of Dudley, 33, 79, 280, 321, 508; of Edinburgh, 37, 76, 129, 181, 218, 275, 320, 420; of Glasgow, 38, 77, 130, 219, 277, 368, 425; of Ireland, 36, 72, 129, 215, 274; of Liverpool, 78, 123; of London, 34, 70, 126, 176, 213, 272, 318, 362, 556; of Manchester, 78, 179, 365; of Norwich, 41, 131, 324, 369, 510, 557
Geologists' Association, 72
Geology applied to the arts and manufactures, 266
— as a branch of general education, 78, 209
— as seen to-day, 1
— errors of, 116
— of Baden, 273; of Berks, 64; of Bucks, 64, 210; of Charnwood Forest, 498; of Cloud Hill, 375; of Coalbrookdale, 514; of Eigg Island, 75; of Franconia, 273; of Herts, 64; of Hobart Town, 491; of Jerusalem, 279; of Kingswood Hill, 111; of Madras, 171; of Matlock, 378; of Mentone, 205; of Middlesex, 64; of Moffat, 320; of New Brunswick, 273; of New Zealand, 270; of Northamptonshire, 210; of Oxfordshire, 210; of Surrey, 64
— of the Berks and Hants Railways, 505; of the British Isles, 125; of the Himalayas, 265, 310; of the Jordan and Dead Sea, 254; of the South Staffordshire coal-field, 501
Germany, glacial drift of N., 218
Gibraltar caves, 213
— Genista cave at, 177
Gilchrist, on ancient sea-beaches, 374
Glacial action at Clitheroe, 199
— clay at Cornton, 182
— drift in N. Germany, 218
— drift of the Shetlands, 341
Glacial lake-basins, 312
— striæ, 478; in Longford, 524
— striation, 513
Glaciation in Devon, 473, 526
Glaciers, action of, 4
— and rock-basins of New Zealand, 35
Glamorganshire, new reptile from the coal shale of, 6
Glasgow Geological Society, 38, 77, 130, 183, 219, 277, 368, 425
— physical geography of, 77
Glyptodon clavipes, 547
Gneiss containing Equisetum, 239
Godwin-Austen, H., on the geology of Kashmere, 363
— R. A. C., on the classification of the Cretaceous rocks, 197
Gold-fields, age of, 332
— of New Zealand, 129, 334, 479
Granite of Ross of Mull, 73
— rocks, crumpled, 216
Graptolites of the Quebec group, 413
Gravels of the Medway valley, 363
Gray, J. E., on *Palæocetus Sedgwicki*, 57
— J. biographical notice of the Rev. D. Ure, 169
Great Britain, physical geology and geography of, 61
Green, A. H., on Ice-scratches in Derbyshire, 440; on the geology of Oxfordshire, Bucks, and Northampton, 210
Gressly, A., obituary notice of, 288
Grindley, T., on tracks in the Manx slates, 542
Gryphæa beds of Loch Aline, 73
Guide to Llangollen, 271
Gümbel, C. W., on freshwater shells in Permian rocks, 204
Gunn, J., on the dip of the chalk in Norfolk, 370
Guppy, R. J. L., on the Tertiaries of Trinidad, 256
Gyrolepis Rankinii, 185

HAAST, J., on a Sketch-map of Canterbury, New Zealand, 30; on the excavation of Lake-basins in New Zealand, 36; on the Pleistocene epoch of New Zealand, 126
Haidinger, W., bust of, 95
Hailes Quarry, glacial action at, 38
Hall, C. R., on the ancient configuration of the N. coast of Wales, 78
— J., Graptolites of the Quebec group, 413
Hanoverian Jura, 501
Harkness, R., on the Connemara rocks, 471; on the Silurian rocks of Cumberland and Westmorland, 176

Harper, J. O., on the *Trogontherium*, 41
Harris, T., fossil jaw-bone of Ruminant from Spithead, 46
Harrison, T., on the geology of Hobart Town, 491
Harrogate, geology of, 128
Harte, W., on crumpled granite rocks in Donegal, 216
Haswell, G. C., on the Silurian rocks of the Pentland Hills, 183, 553
— J., on a glacial clay at Cornton, 182
Haughton, S., on the geology of the western isles of Scotland, 73
— Manual of Geology, 449
Hazel-nuts in an alluvial deposit at Collyhurst, 79
Hector, J., on the Geology of Otago, New Zealand, 35; on the rock-basins of New Zealand, 377
Herschel, J. F. W., on rhomboidal ironstone, 273
Hertfordshire, geology of, 64
Himalayas, geology of, 265, 310
Histioderma Hibernicum, 398
Hobart Town, geology of, 491
Holl, H. B., on the geology of the Malvern Hills, 317
Holmström, L. P., Vestiges of the Ice-period, 545
Housman, H., on Palæontology, 33
Hoyle's Mouth Cave, 471
Hull, E., on the Lancashire Pebble-bed, 429
Hull, Literary and Philosophical Society, 225
Hunter, J. R. S., on the Carboniferous limestones of Carluke, 275
Huxley, T. H., on the structure of Belemnites, 67
— and R. Etheridge's Catalogue of fossils, 268.

ICE-ACTION of Scotland and Switzerland, 187
Ice-age in Scotland, 183; of Sweden, 545
Ice-caves, 85; of France and Switzerland, 449
Ice-scratches in Derbyshire, 440
Ilford, exhumation of the cranium of the mammoth at, 93
Indentations in bones of *Cervus megaceros*, 28, 216
Inversion of strata, 206
Iona, crystalline white limestone of, 73
Ireland, Drifts of, 92
— *explanations of geological survey maps of*, 211
Ireland, Royal Geological Society of, 36, 129, 215, 274
Iron pyrites, magnetic, in clay, 234

JADE from Siberia, 95
Jamieson, T. F., on the last geological changes in Scotland, 71
Jeffreys, J. G., on fossil shells in the sea-bed near the Channel Isles, 517
Jenkins, H. M., Strata Identified by Organic Remains, 554
Jerusalem, geology of, 279
Jevons's, W. S., The Coal Question, 550
Johnson, H., on the South Staffordshire Coal-field, 280
Jones, J., on Organization in Field-club Work, 34
— T. R., on *Eozoön Canadense* in the Connemara Marble, 88; on the Microzoa from the Nar Valley, 306
Jordan, geology of, 254
Jukes, J. B., on a comparison of the rocks of S. W. Ireland, N. Devon, and Rhenish Prussia, 275; on glaciation in Devon, 473; on Indentations in bones of *Cervus megaceros*, 28, 216; on the carboniferous limestone outlier near Corwen, 326; on the former extension of the Coal-measures, 135; on the South Staffordshire Coal-field, 501

KASHMERE, Carboniferous rocks and fossils of, 363
Keddie, W., on the unity and permanence of species, 188
Keene, W., on the Coal-measures of New South Wales, 70
Kelly, J., on the doctrine of Characteristic Fossils, 37
— Errors of Geology, 116
Kermesite, 238
Kesteven, W. B., on the spongeous nature of flint fossils, 329
Ketley, C., on the Silurian rocks and fossils of Dudley, 509
Kettle R., on the working of the Ten-yard coal, 34
Kinahan, G. H., on Glacial Striæ, 473; on preglacial (?) drift in Queen's County, 442; on primary and secondary striæ, 525; on the Irish drifts, 92
King, W., jun., and R. B. Foote's Geology of Madras, 171
Kingswood Hill, geology of, 111
Kirkham, J. W., on the Boulder-clay of Heaton Mersey, 381
Knowle, Lias outlier at, 71

LABROID Fishes, new family of, 411
Lake-basins, excavation of, in hard rocks, 36; formation of, 291
Lake-district, surface-geology of the, 299
Lake-habitations of Neufchâtel, 26
Lakes, origin of, 5
Lancashire Pebble-beds, 429
Lankester, E. R., on the *Cephalaspis* and *Pteraspis*, 517; on the crags of Suffolk and Antwerp, 103, 149; on the sources of the Red Crag Mammalia, 128
Lartêt, E., on *Ovibos moschatus*, 318
Latacunga, Volcanic tufa of, 176
Laurentian Rocks, 34, 147: organic remains in, 35
— of Charnwood forest, 233; of Europe, 97; of the Malverns, 317
Leaf-bed of Alum Bay, 515; of Ardtun Head, 74
Leckenby, J., on the Boulder-clay of East Yorkshire, 347
Lecoq, H., on mineral waters, 115, 164, 351
Lepidostrobus, 437
Leonhard and Geinitz's Neues Jahrbuch für Mineralogie, Geologie, und Paläontologie, 60
Lexden, sinking of ground at, 101, 231
Lias of Lyme Regis, 519; of Pabba, 74
— outliers in Shropshire, &c., 227; in South Warwickshire, 71
Liassic crinoidal limestone of Lower Austria, 17
Liége bone caves, 227
Lindsay, L., on the gold-fields of New Zealand, 129
Literary and Philosophical Society of Hull, 225; of Manchester, 41
Liverpool Geological Society, 78, 123
Luna, R. de, on deposits of phosphate of lime, 446
Llandudno, pockets in Mountain-limestone at, 203
Llangollen, guide to, 271
Loess of England and France, 19; at Sangatte, 362
Loew, on new Tertiary fossils, 266
Logan, W. E., on the Laurentian rocks of Canada, 34
London basin, section of the, 65
— clay, new mammals from the, 339
London Geological Society, 34, 70, 126, 176, 213, 272, 318, 362, 556
Lorenz, brackish waters and their deposits, 16
Ludwig, R., on Calamite-fruits, 544
Lyell's, C., Elements of Geology, 167
Lyme Regis, Lower Lias of, 518

MACCLESFIELD, Glacial shells of, 41; drift-beds of, 365; drift fossils of, 298
Mackintosh, D., on atmospheric and oceanic denudation, 519; on Charnwood Forest, 498; on the Brimham rocks, 154; on the geology of Matlock, 378; on the Surface-geology of the Lake-district, 299
Macrauchenia patachonicha, 451, 520
Madras, geology of, 171
Magnesia in rocks, 278
Magnesian limestone of Durham, 29, 355
Magnetic Iron Pyrites in clay, 234
Maldive Islands, disappearance of one of the, 139
Malta, Cycloid fish from, 145
Maltese Caverns, 520; fossil elephant of the, 334, 488
Malvern Hills, geology of, 317
— Naturalists' Field Club, 231, 325, 426
Mammalian Fossils from Uruguay, 528; from Yorkshire, 364
Mammalia of the Red Crag, sources of the, 128; of the Somersetshire Caverns, 43
— Preservation of fossil, 239
Mammoth drawn on ivory, from cavern at Périgord, 480
— at Ilford, exhumation of the, cranium of the, 93
Manchester Geological Society, 78, 179, 365; Literary and Philosophical Society, 41
Mankind, Early History of, 174
Manx slates, tracks in, 542
Marginella, new species of, 536
Marianville, discovery of flint weapons at, 76
Marsden's, T., Sacred Steps of Creation, 417
Martin, L., and F. Garrigou, on the relations of the mineral springs of S. France, to metamorphic rocks and lines of fissure, 58
Massalongo, A. B., Photography applied to Palæontology, 19
Matlock, geology of, 378
Matthew, G. F., on the geology of South New Brunswick, 273
Maw, G., glaciation in Devonshire, 526; on a white sand deposit at Tarlargoch Mine, 428; on deposits of chert, white sand and clay, near Llandudno, 200; on the Permian strata of Clwyd Vale, 380, 523
Medlicott, H. B., on Himalayan geology, 310

Medway gravels, 363
Mello, J. M., on the Bloody Stone, 526
Mendip Caves, Teeth of *Felis antiqua* from the, 43
Mentone, inversion of strata at, 206
Meteorites, physical history of, 447
Mexico, Anthracite in, 192
Middlesex, geology of, 64
Milford Hill, Flint Implements at, 177
Millstone-grit fossils, 107; 552
— of Kingswood Hill, 110
Mineral springs, relations of, to metamorphic rocks and lines of fissure, 58
Mineral Waters, 115, 164, 351
Mining notes, 94
Miocene fish from Malta, 145
Miolophus, 339
Miscellaneous, 47, 93, 139, 191, 236, 286, 330, 383, 432, 478, 528, 572, 576
Mitchell, W. S., on leaf-forms from Alum Bay, 515
Moffat, geology of, 320; Silurian shales of, 431
Morant, A. W., formation of flints in chalk, 132
Morecambe Bay, earthquake at, 191
Mountain-limestone Echinodermata, 245
— of Lancashire, new species of *Actinocrinus* from the, 12
— of Yorkshire, 163; 'pockets' in, 203
Mountains, origin of, 315
Mount Sorrel syenite, 448
Mull, Granite of Ross of, 73; Oolite of, 74
Murchison, R. I., Address to British Association, 462; on the Notes and Map of Dr. Haast, 35; on the Laurentian rocks, 97, 147; on the rock-basins of New Zealand, 377
Museum of Buenos Ayres, 451

NAR, Brick-earth of the, 8; list of organic remains of the, 11; Microzoa of the, 306
Natural History and Antiquarian Field Club of Bath, 80
Natural History Review, 412
Natural History Society of Dumfriesshire and Galloway, 226, 373; of Newcastle, 223; of Northumberland, Durham, and Newcastle-on-Tyne, 42
Naturalist and Scientific Society of Wigan, 224
Naturalists' Club of Belfast, 135
— Field Club of the Cotteswolds, 228, 371; of Malvern, 231, 325; of N. Staffordshire, 374; of Oswestry and Welshpool, 82, 211, 373, 427, 511; of Richmond, 229, 325, 512; of Warwickshire, 227
Naturalists' Society of Bristol, 42, 132, 222, 321; of Warrington, 376
Nephrite from Siberia, 95
Neufchâtel, Lake-habitations of, 26
New Brunswick, geology of, 273
Newcastle Natural History Society, 223
Newer Pliocene Mammalia of Somersetshire, 43
New South Wales coal-basin, 235
— coal-measures of, 70: new gold-fields in, 333
New Zealand, excavation of lake-basins in, 36
— Geology of, 270; geology of Otago, 35; glaciers and rock-basins of, 35
— Glaciation during Pleistocene and recent times in, 36
— Gold-fields of, 129, 333, 479; origin of rock-basins of, 377; Pleistocene epoch of, 126; rivers and plains of Canterbury, 269
Nile, fluviatile deposits of the, 213
Northamptonshire, geology of, 210
Northumberland, Durham, and Newcastle on Tyne, Natural History Society of, 42
Norfolk, dip of chalk in, 370
Norwich Geological Society, 41, 131, 324, 369, 510, 557
— Pliocene and Post-pliocene deposits of, 79
Nova Scotian Institute, 124

OBITUARY notices of A. G. Bain, 47; N. R. Bouchard, 96; H. Christy, 286; Dr. H. Falconer, 142; A. Gressly, 288; Sir J. Richardson, 335; Professor B. Silliman, 95; and Dr. S. P. Woodward, 383
O'Hara, H., on the Irish coal-fields and peat-bogs, 34
Oldhamia antiqua, 391, 394; *O. radiata*, 395
Oolite of Mull, 74
Origin of screes, 300; of cwms, 303; of mountains, 315
— of species, 308
Ormsby, geology of, Eigg Island, 75
Oswestry and Welshpool Naturalists' Field Club, 82, 211, 343, 373, 427, 511
Otago, Geology of, 35
Outliers of Carboniferous Limestone near Corwen, 326; of Lias in South Warwickshire, 71
Ovibos moschatus, 318
Owen, R., on a fossil fish from Malta, 145; on an air-breathing vertebrate

from the coal-shale 6; on a new mammal from the London clay 389; on *Macrauchenia patachonica*, 520; on Van Beneden's 'Recherches sur les Squalodons,' 405
Oxford fossils, No. 1, 292
Oxfordshire, geology of, 210

PABBA, Lias of, 74
Page, D., Address to Edinburgh Geological Society, 37, 420; on geology as a branch of general education, 78, 209; on the 'Wash out' at Hailes Quarry, 36
Palechinus, structure of, 44; *P. ellipticus*, 217
Palæocerus Sedgwicki, 54, 57
Palæontographical Society, 192
Palæontology, 33
Palestine, geology of, 254
Paraffine-oil, manufacture of, 479
Parker, on the bone-caves of Liége, 227
Parker, W. K., and T. R. Jones's Foraminifera from the North Atlantic and Arctic Oceans, 548
Peach, C. W., on glacial drift in the Shetland Isles, 341
Peat-bogs of Ireland, 34
Pechell, A. H., on magnetic iron-pyrites in clay, 234
Penarth beds, 482
Pengelly, W., on the Antiquity of Man, 348
Pentland Hills, Silurian rocks of the, 553
Pentremites, 248
Permian strata of Clwyd Vale, 380, 523; of Thuringia, 204
Perforated rocks, 156
Peters, Liassic crinoidal limestone of Lower Austria, 17
Pharyngodopilidæ, 411
Phillips, J., Address to British Association, 456; on glacial striation, 513; on Oxford fossils, No. 1, 292; on the geology of Harrogate, 128; on *Xiphoteuthis elongata*, 57
Phosphate-bed at Folkestone, 527
Phosphate of lime, deposits of, 446
Photography applied to Palæontology, 19
Phyllodus, new species of, 412
Pillar Rock, 305
Plant, J., on a bed of hazel-nuts in an alluvial deposit at Collyhurst, 79; on spurious fossils, 179; on the Laurentian (?) rocks of Charnwood Forest, 233
Pleistocene epoch, climate of, 126
Pliocene and post-pliocene deposits of Norwich, 79
Pluvial action, 300
Polacanthus, 432
Polyporites, 404
Porana, 516
Porphyritic rocks of Charnwood Forest, 500
Post-tertiary fossils, from the valley of the Nar, 11
Prairies, origin of, 208
Prasine, 257
Pre-Cambrian Island of St. David's, 430
— Life-eras, 18
Preglacial (?) drift in Queen's County, 443
Prestwich, J., geological position and age of the flint-implement-bearing beds, 19; on the raised beach of Sangatte, 362
Primary and secondary glacial striæ, 478, 525
Progress of Geology, 387
Prosser, W., on fossils in the Millstone-grit, 107
Protolycosa anthracophila, 468
Pteraspis, 517
Purton, W., on the geology of Coalbrookdale, 514

QUARTERLY Journal of Science, 121, 554

RAISED beach of Sangatte, 362
Ramsay, A. C., on glacial lake-basins, 212
— Physical Geology and Geography of Great Britain, 61
Randall, J., on the burning well at Broseley, 232
Recent Erratic block, 37
Red Crag Mammalia, sources of the, 128
Reid, J., on movements in the earth's crust, 131
Reynès, P., on the Cretaceous rocks of France and England, 113
Rhætic beds, palæontology of the, 489
Rhenish Provinces, geological map of, 400
Rhinoceros leptorhinus from Ilford, 334
— *megarhinus*, 413
Rhodocrinus, 247
Rhomboidal ironstone, 270
Richardson, J., Obituary notice of, 336
Richmond and North Riding Naturalists' Field Club, 220, 320, 512
Rivers, action of, 303
River-valleys, excavation of, 108

Roberts, G. E., geological notes, 163; geological notes and queries, 89; geological notes on Scotland, 252; on the rocks and minerals of Finland, 534; Pre-Cambrian Life-eras, 13
Rock-basins of New Zealand, 35, 377
Rocks and fossils, sequence of, 45, 262
Rocking Stones, 156
Rofe, J., new species of *Actinocrinus*, 12; on Echinodermata, 245
Römer, F., on a fossil spider, 468
Romney Marsh, 210
Rose, C. B., on the brick-earth of the Nar, 8
Rubidge, R. N., on the geological map of S. Africa, 274
Ruminant, fossil jaw-bone of, from Spithead, 46
Ruskin, J., on the structure and denudation of the Alps, 49, 193
Rutley, F., on the Lexden pit, 231

ST. DAVID'S, Pre-Cambrian Island of, 430
Sainter, on the Macclesfield drift-beds, 365
Salter, J. W., on new fossils from the Lingula-flags, 318; on the Pre-Cambrian Island of St. David's, 430
Sandberger, F., on the geology of Baden and Franconia, 273
Sandstone with surface-markings, 189
Sanford, W. A., on *Eozoön Canadense* in Connemara Marble, 87; on teeth of *Felis antiqua* from the Mendip Caves, 43
Sangatte raised beach, 362
Schistopleurum typus, 400
Scientific Exploring Expedition, 335
Scotland, crag in, 127; geological notes on, 253; geology of the western isles of, 73; last geological changes in, 71
Sections at Bray Head, 390; at Coalbrookdale, 515; at Corwen, 283, 326, 327; at Ely, 530, 532; at Great Orme's Head, 200; at Hobart Town, 492, 493; at Lexden, 101, 231; at Mentone, 206; at Newton, Queen's County, 443, 444; at Oswestry, 108; at Stapleton, 111; and at Tottenhill Brickfield, 10
— of Clwyd Vale, 380; of Grundy Hill, near Manchester, 382; of Kunjamullay, 173; of Mont Salève, 52; of the Antwerp Crag, 105; of the London Basin, 65; of the rocks of North Wales, 344
Seebach, K. von, 'Der Hannoversche Jura,' 501
Seeley, H., on the sequence of rocks and fossils, 45, 262; on bones of a fossil whale from near Ely, 54; on the Cretaceous Beds at Ely, 530
Senarmontite, 238
Sequence of rocks and fossils, 45, 262
Shetland Isles, glacial drift in the, 341
Silica, its mode of formation in the earth's crust, 220
Silicious sand at Talargoch Mine, 428
Silliman, B., obituary notice of, 95
Silurian fossils, distribution of the Upper, 281
— fossils of the Pentland Hills, 183
— rocks and fossils of Dudley, 509
— rocks of Cumberland and Westmoreland, 176; of the Pentland Hills, 553
— Shales of Moffat, 431
Silver Peak, 478
Sinking of ground at Lexden, 101, 286
Sismonda, A., on an Equisetum in gneiss, 239
Skipsey, R. W., on Lower Carboniferous fossils from the Upper Coal-measures, 186; on the trap-rocks of the Catkin Hills, 131
Skye, Syenite of, 73
Smyth, T., on glacial drift in N. Germany, 218; on the upheaval of the shores of the Firth of Forth, 76; recent upheaval of Firth of Forth, 181
Solaro, J. M. S., Discovery of the pelvis of *Dinotherium*, 18
Somerville, A., on ganoid Carboniferous fishes, 320
— G., on the geology of Jerusalem, 279
Sorby, H. C., on meteorites, 447; on the Mount Sorrel syenite, 448
Southern Counties Association, 139
Spider from the Coal-measures, 468
Spongeous nature of flints, 329
Spruce, R., the Quitenian Andes, 176
Squalodons, 405
Staffordshire Coal-field, South, 280; North, 569
— Naturalists' Field Club, 374
Stephenson, G., anecdote of, 528, 570
Stereodus Melitensis, 145
Stewart, N., on fossil trees in sandstones, 420
Stoddart, W. W., on the Cambro-Silurian strata, 222; on the Carboniferous rocks at Clifton, 83
Stoliczka, F., on Himalayan geology, 265; on the Cretaceous Cephalopoda of S. India, 272
Stone Implements in Madras, 503
Strata identified by Organic Remains, 554
Suess, E., on *Acanthoteuthis*, 444

Suffolk Crags, 103, 149
Sulphate of baryta, 475
Surface-marks on Carboniferous sandstone, 136; on sandstone, 189
Surrey, geology of, 64
Sutherland, J., on silica, 220
Sweeney, Millstone-grit at, 107
Syenite of Mount Sorrel, structure of the, 448
— of Skye, 73
Syenitic knolls, 499
Symonds's, W. S., Old Bones, 125

TABLE of the diluvial formations, 360; of the divisions of the Cretaceous rocks, 114; of the relations of the crags of Suffolk and Antwerp, 151
Talitrus saltator, 190
Tasmanite, 237
Taylor, J. E., on an anticlinal in the chalk at Whitlingham, 324; on the drift beds near Saxlingham, 511; on the drift of Whitlingham, 370; on the Pliocene and post-Pliocene deposits of Norwich, 79
Teeth of crustacea, 401
Tellina proxima bed, 127
Tertiary deposits of Victoria, 214
— Fossils from Trinidad, 257; from Vienna, 266
— leaf-beds of Ardtun Head, 74
Thirsk, coal-field at, 140
Thanet, chalk of, 214
Tomlinson, C., on the Chesil Bank, 72
Topley, W., and C. Le N. Foster on the Medway gravels, 363
Torrell, O., on the Ice-period, 545
Tottenhill Brick-field, section at, 10
Totternhoe stone, 215
Tracks in the Manx slates, 542
Transactions of the Glasgow Geological Society, 507
Trap rocks of Bray Head, 217; of the Catkin Hills, 131
Travertin, analysis of, 354
Tree-fern from the Upper Greensand, 484
Trees, erect stems of, in trappean ash, 474
Triassic age of the Lancashire Pebble-bed, 429
— Reptiles, 140; rocks of California, 307
Trichecodon Huxleyi, 128
Trinidad Tertiary deposits, 256
Tristram, H. B., on the valley of the Jordan, &c., 254
Trogontherium, 41
Tschermak, on the group of feldspars, 445
Tungsten, 509
Turrilepas Wrightii, 319, 470
Twamley, C., on the faults of the South Staffordshire Coal-field, 508
Tylor's, E. B., Early History of Mankind, 174

UNCONFORMABILITY, 476
Unger, on the Fossil plants of Hungary, 445
Upheaval of the shores of the Firth of Forth, 76, 181, 277, 328

VICTORIA, Tertiary deposits of, 214
Vogt's, C., Lectures on Man, 357
Volcanic eruptions in Central France, 241
— tufa of Latacunga, 176

WALES, ancient configuration of the N. coast of, 78
Wales, South, coal basin of, 158
Wallace, W., on the growth of flos ferri, 272
Ward, J., on Lower Carboniferous fossils, 234
Warren, C., on the Gibraltar caves, 213
Warrington Field-Naturalists' Society, 376
Warwickshire, Lias outliers in, 71
— Naturalists' Field Club, 227
Water-supply of the Permian rocks, 355
Weald, denudation of the, 363
Westmoreland, Lower Silurian rocks of, 176
Westropp, W. H. S., on a trap-rock at Bray Head, 217
Whale, fossil neck-bones of, 54
Whitaker's, W., Geology of parts of Middlesex, Herts, Bucks, Berks, and Surrey, 64
— on the Chalk of Thanet, 214; of the I. of Wight, 215; of Buckinghamshire, 215
Whitley, N., the 'flint implements' from drift, not authentic, 455
Whitney, on the Trias of California, 307
Whittaker, J., on an outcrop of the Lower Coal-measures at Boulsworth, 180
Wigan Field Naturalist and Scientific Society, 224
Winchell, A., on the prairies of the Mississippi, 208
Winkler, T. C., Catalogue of the Collection of the Teyler Museum, 555
Winwood, H. H., on 'Hoyle's Mouth' Cave near Tenby, 471
Wollaston Medal, award of, 139

Wood, fossil, from the chalk, 292
Wood, E., address to Richmond Naturalists' Field Club, 229
— S. V. jun., on the drift of the E. of England, 70
***Woodocrinus expansus*, 163**
Woods, J. E. T., on the Tertiary deposits of Victoria, 214
Woodward, H., on a chart of Crustacea, 468; on a new genus of *Cirripedia*, 318; on a new genus and new species of *Eurypterida*, 319; on crustacean teeth, 401; on the extraction of the Mammoth from the Brick-earth at Ilford, 93
— S. P., Post-tertiary fossils from the Nar Valley, 11
— obituary notice of, 383
Wootton Wawen, Lias outlier at, 71
Wight, Chalk of the Isle of, 215
Wright, T., on the development of Ammonites, 86
Wünsch, E. A., on erect stems of trees in trappean ash, 474

X*IPHOTEUTHIS*, 67; *X. elongata*, 57, 189

YORKSHIRE, glacial beds of East, 348; new coal-field in, 140
Young, J., on Devonian and Carboniferous sandstones, 39; on a new mineral 'Ferrite,' 40; on the products of the distillation of coal-tar, 184
— J. W., analysis of 'Ferrite,' 40; on a deposit containing sulphate of baryta, 475; on the presence of magnesia in rocks, 278
— and W. Carruthers, on the Silurian Shales of Moffat, 431

ZEUGLODONTS, 405

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p. 184. line 14 from bottom, *for* John Young *read* James W. Young.
p. 188. line 12 from bottom, *for* Winch *read* Wünsch.
p. 215. line 22 *for* of *read* and.
p. 219. bottom line, for *tuberculosus* read *nodiferus*.
p. 372. line 17 *for* Coptford *read* Copford.
p. 380. woodcut, *for* Pentre Glyn *read* Pentre Celyn.
p. 381. line 32 *for* Abbersley *read* Abberley.
p. 394. line 16 from bottom, *for* 5 *a read* 4 *b*.
p. 397. line 3 from bottom, *for* 4 *b read* 3 *b*.
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